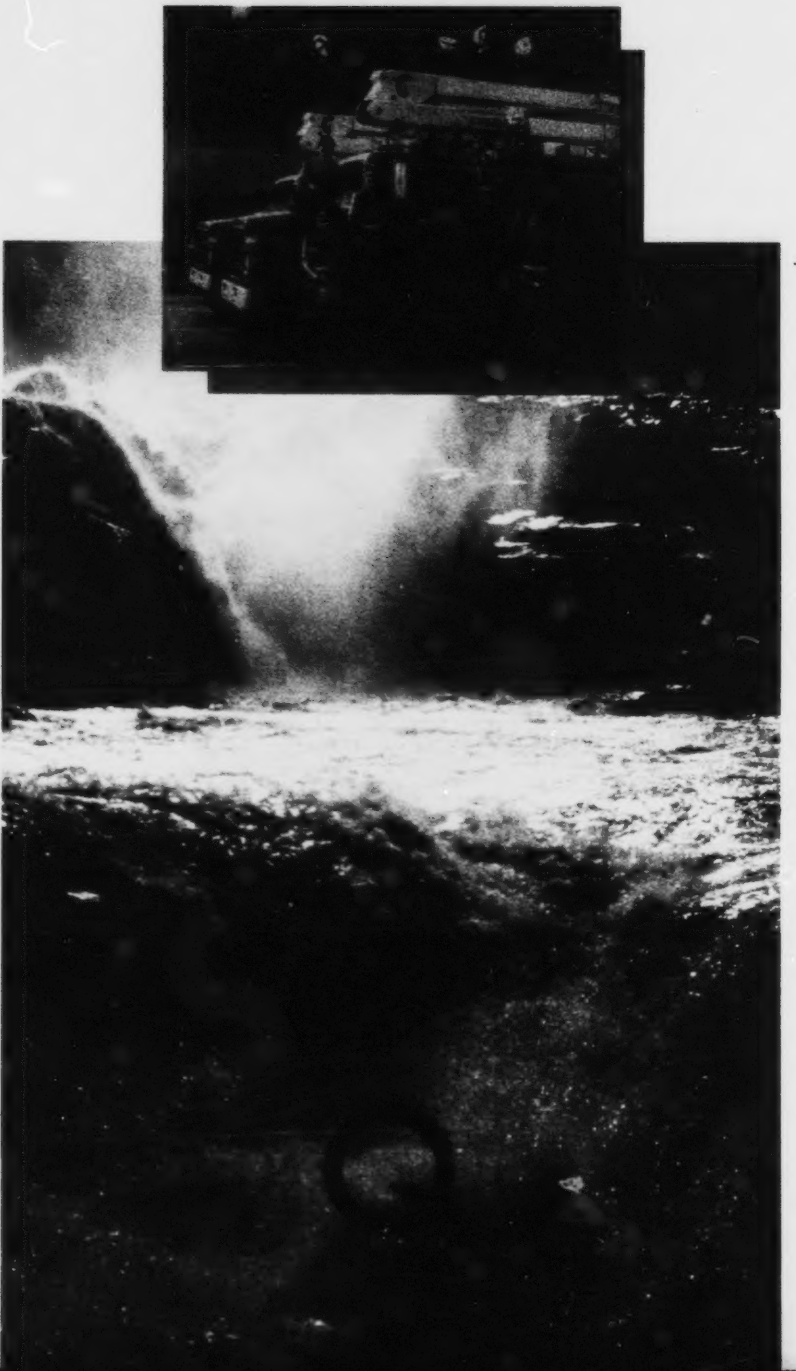
Hydro-Québec Development Plan 1988-1990
Horizon 1997

. . . .

Abridged version



March 1988

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This document provides a general summary of the *Hydro-Québec Development Plan 1988-1990 Horizon 1997.*

The cover photographs show the Broadback Falls in the James Bay region and some of Hydro-Quebec's first women line workers.

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FOREWORD

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Hydro-Québec is a Québec Government-owned corporation created in 1944 and given the principal mandate of supplying the province with electricity under the best possible conditions. With about 19,000 employees and more than $31 billion in assets, it is Canada's second largest non-financial corporation. It owns and operates 80 generating stations with installed capacity of 24,533 megawatts. In 1987, it sold 153 billion kilowatthours of electricity, including 29 billion outside Québec. It also carries on activities in various fields related to its mandate, such as research, promotion, energy transformation and conservation, and environmental protection.

This document summarizes the main points contained in the Hydro-Québec Development Plan 1988-1990 Horizon 1997. It has been prepared for the Government of Québec - the utility's sole shareholder - and for its partners and collaborators. It sets out Hydro-Québec's orientations, objectives and strategies, as well as its development prospects, with a view to eliciting greater concerted effort from all parties concerned.

Although this document covers the decade to come, it focuses on measures to be taken in the next three years. It reviews the action taken in recent years, which have been characterized by vigorous recovery measures, and provides an update on Québec and external markets, the operation and development of Hydro-Québec's power system, human resources management, the development of new technologies, and financial management. It also discusses the interaction between Hydro-Québec's various strategies and explains how its activities benefit both its partners and Québec as a whole.

Note to Readers

Unless otherwise indicated, the data in this document are those of Hydro-Québec.

Symbols for Units of Measurement

kV - kilovolt (unit of voltage)
kWh - kilowatthour (unit of energy)
GWh - gigawatthour, or 1 million kilowatthours
TWh - terawatthour, or 1 billion kilowatthours
MW - megawatt (unit of power)

1. RECOVERY YEARS

After several difficult years, Hydro-Québec is re-establishing its financial equilibrium. In the short term, the utility intends to consolidate the recovery measures it began implementing in 1982, to rapidly achieve a level of profitability that will enable it to fulfill its mandate without imposing rate shocks on its customers.

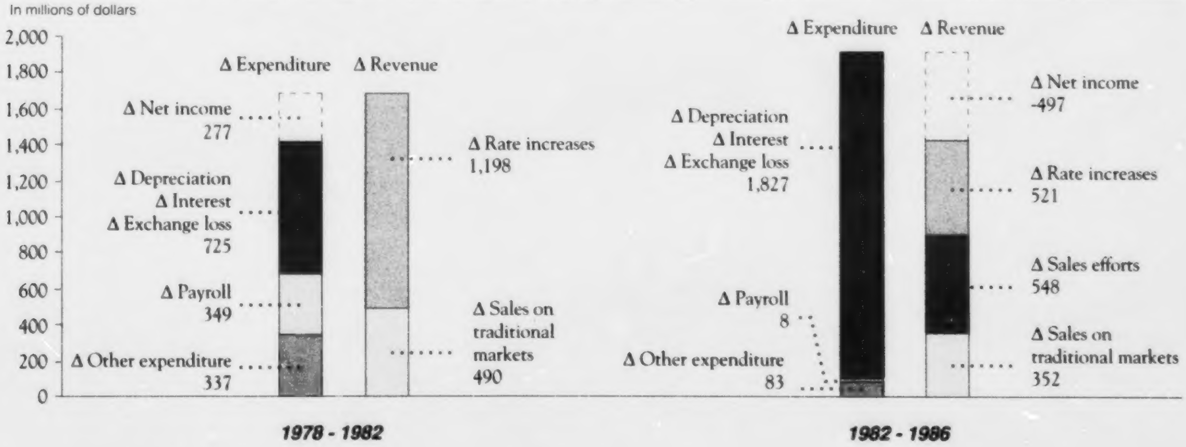
The energy crisis and the recession of the early 1980s caused a serious imbalance between electricity supply and demand, and a serious deterioration in the utility's financial situation. Hydro-Québec had to radically curtail its construction program. Of the approximately 26,000 megawatts scheduled for commissioning from 1985 to 1997 according to the 1980 forecasts, only 6,500 will be commissioned during this period according to the current scenario.

During these difficult years, the utility had to undertake a dynamic marketing effort. It launched new offensives on Québec and external markets and, on Québec markets, limited its rate increases to sustain these marketing programs. At the same time, it slashed expenditure: from 1982 to 1987, the average yearly increase in operating expense was 5.0%, compared with 20.5% from 1976 to 1982. Despite these measures, net income fell temporarily.

The results of this recovery strategy have gradually made themselves felt. In 1987, the return on equity increased for the second consecutive year, after dropping since 1982. To consolidate this financial turnaround and to maintain its competitive edge, Hydro-Québec intends to pursue its efforts to increase productivity and reduce expenditure.

FIGURE 1
IMPACT OF THE RECOVERY STRATEGY ON FINANCIAL RESULTS

Variation (Δ) in revenue and expenditure per four-year period*



*1986 breakdown revised

N.B.: The financial imbalance was due mainly to an increase in depreciation, interest and exchange loss. Between 1978 and 1982, this expenditure increased by $725 million, whereas from 1982 to 1986 it jumped by $1,827 million.

During this period, Hydro-Québec had large amounts of surplus electricity and had to limit its rate increases, while at the same time growth on traditional markets slowed.

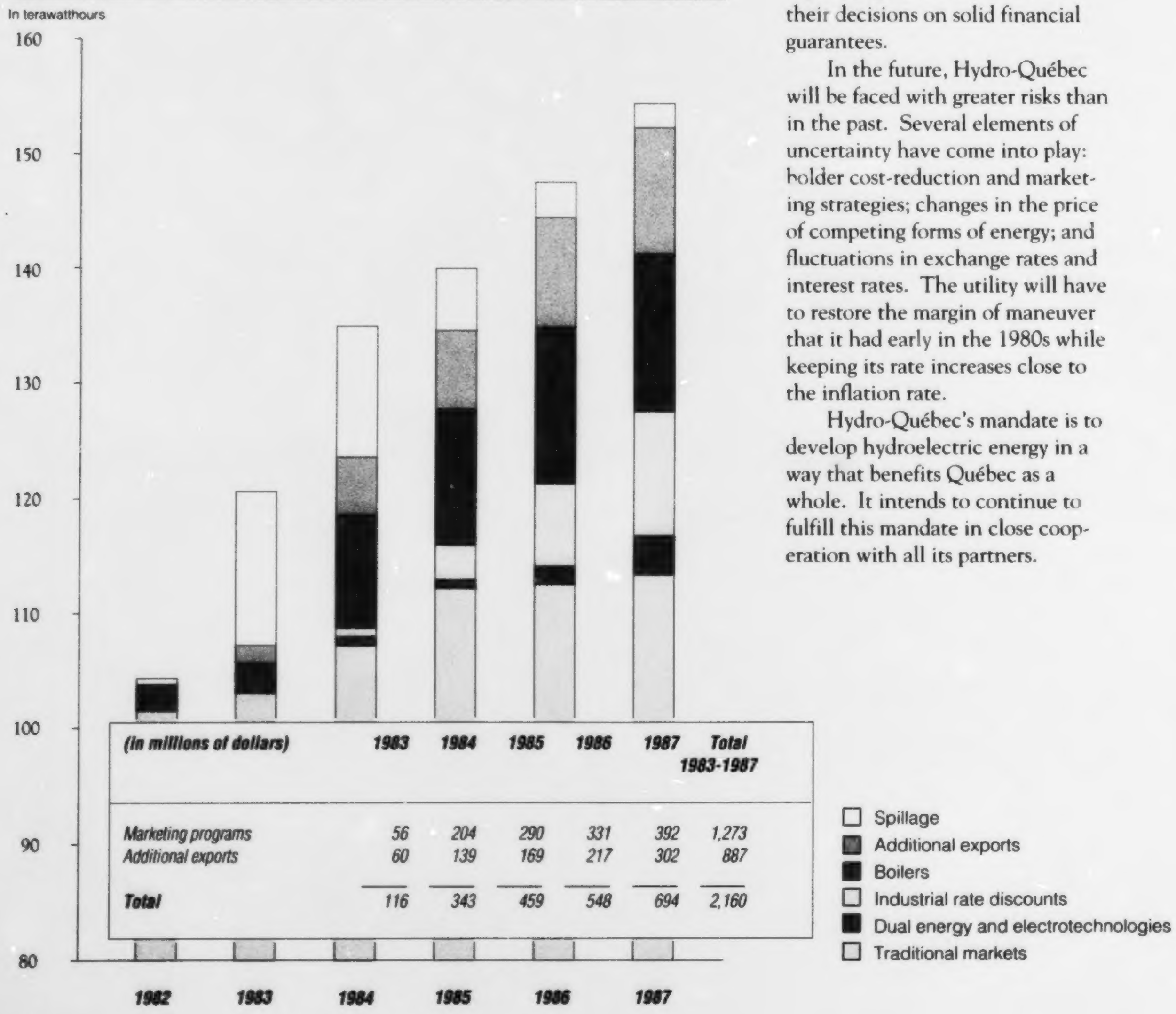
To offset the deterioration in net income, the utility limited increases to operations payroll and intensified its sales efforts. Despite these steps, net income dropped by $497 million.

Both in the short and long term, its main orientations remain the same: a greater share of Québec and external markets, cost reduction, power system development as a function of profitable markets, technological leadership and, ultimately, diversification. With the collaboration of its employees, suppliers and outside contractors, the utility aims to meet the expectations of its three principal partners: its customers, to whom it intends to offer advantageous and stable rates, as well as quality service; the Government of Québec, which, as Hydro-Québec's sole shareholder, expects it not only to declare dividends but also to generate socio-economic benefits and manage land use harmoniously; and its lenders, who provide the utility with three-quarters of its capital requirement and must base their decisions on solid financial guarantees.

In the future, Hydro-Québec will be faced with greater risks than in the past. Several elements of uncertainty have come into play: bolder cost-reduction and marketing strategies; changes in the price of competing forms of energy; and fluctuations in exchange rates and interest rates. The utility will have to restore the margin of maneuver that it had early in the 1980s while keeping its rate increases close to the inflation rate.

Hydro-Québec's mandate is to develop hydroelectric energy in a way that benefits Québec as a whole. It intends to continue to fulfill this mandate in close cooperation with all its partners.

FIGURE 2
IMPACT OF SALES EFFORTS



(In millions of dollars)	***1983***	***1984***	***1985***	***1986***	***1987***	***Total 1983-1987***
Marketing programs	*56*	*204*	*290*	*331*	*392*	*1,273*
Additional exports	*60*	*139*	*169*	*217*	*302*	*887*
Total	*116*	*343*	*459*	*548*	*694*	*2,160*

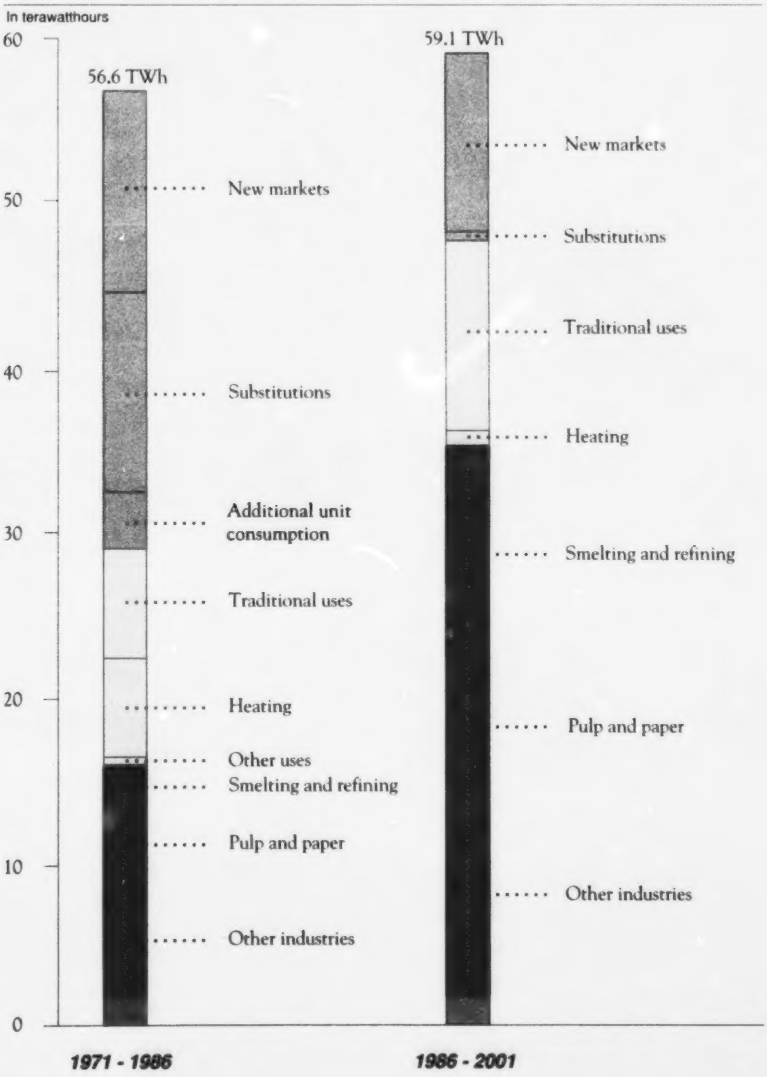
2. MARKETS

Québec Markets: Accent on Industry

Sales of firm electricity increased by 5.4% a year between 1971 and 1986. One-half of this growth took place in the residential and farm sector, primarily because of electric heating. From 1986 to 2001, sales of firm electricity will increase by only 3.1% a year. During this period, the industrial sector will account for one-half of the growth. The main reasons are the opening of new plant in large-power industries and the modernization of existing facilities. The proximity of large markets and the relatively low price of electricity will attract new aluminum and magnesium plants, as well as other smelting and refining facilities. A large portion of the increase will come from the modernization of pulp and paper plants and, to a lesser extent, greater use of electrotechnologies.

Growth in the residential and farm sector will be based solely on demography and economic activity, as the oil-replacement markets are virtually saturated.

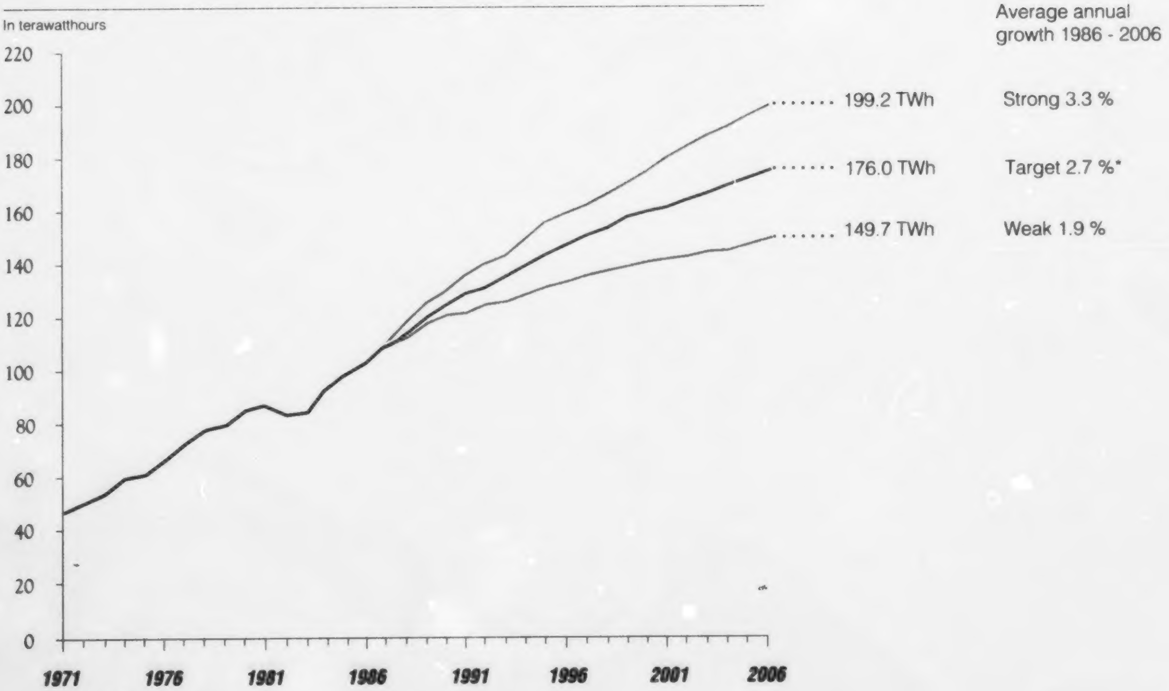
FIGURE 3
GROWTH OF HYDRO-QUÉBEC'S FIRM ELECTRICITY SALES IN QUÉBEC



▨ Residential and farm sector
☐ General sector
■ Industrial sector
▨ Other

The electricity demand forecast is based on various scenarios established as a function of changes in demography, the economy and the energy context. Three scenarios have been established for firm electricity sales from 1988 to 2006: a medium-growth target scenario of 2.7%, a low-growth scenario of 1.9% and a high-growth scenario of 3.3%.

FIGURE 4
SCENARIOS FOR SALES OF FIRM ELECTRICITY BY HYDRO-QUÉBEC IN QUÉBEC



* 3.1% from 1986 to 2001.

A Well-targeted Marketing Plan

As in the previous development plan, Hydro-Québec's 1988-1990 marketing plan is based on three major orientations: improved customer service, selective market development and gradual realignment of rates.

Customer Service

In recent years, Hydro-Québec has revised its marketing practices, placing greater emphasis on customer satisfaction. The areas Hydro-Québec will be concentrating on in order to improve customer service include personalized and more frequent contact with customers, new business practices, advantageous supply conditions and improved continuity of service. The challenge of the years to come will be to gradually implement the improvements resulting from these revisions.

Selective Development of Québec Markets

Hydro-Québec will develop new markets to replace those opened temporarily to sell its surpluses. In particular, the utility will promote the use of electricity in off-peak periods. This strategy will limit the need for new peak-load facilities, which will in turn lower generating costs and hold rate increases down, thereby benefitting residential and industrial customers alike. Energy conservation and the efficient use of electricity will continue to be promoted.

A range of programs is already in place to boost sales to the industrial sector. Hydro-Québec offers an interruptible power program that features discounts for customers agreeing to interrupt a portion of their consumption during critical periods. Because of gradual improvements to rates mechanisms, interruptible power stock should increase from 500 to 2,000 megawatts by 1995. With respect to the risk and profit sharing program available since 1986,

TABLE 1
TARGET SCENARIO
SALES OF FIRM ELECTRICITY BY HYDRO-QUÉBEC IN QUÉBEC

(in terawatthours)

Sector	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1996**	**2001**	**2006**	**Growth 1986-2006 in %**
Residential and farm	40.5	40.4	42.5	43.1	43.8	44.1	48.6	51.8	54.3	1.5
General	22.2	23.9	25.2	26.4	27.1	27.8	31.6	35.2	38.7	2.8
Industrial	36.5	41.7	43.8	46.6	49.7	52.4	62.3	69.9	76.7	3.8
Other	4.2	4.4	4.4	4.4	4.5	4.7	5.2	5.8	6.4	2.0
TOTAL	103.5	110.4	115.9	120.5	125.1	129.0	147.7	162.6	176.0	2.7
Annual growth										
• in TWh	5.9	6.9	5.5	4.6	4.5	3.9	3.8	3.0	2.7	
• in %	6.0	6.6	5.0	4.0	3.8	3.1	2.8	1.9	1.6	

the utility intends to pursue this strategy, which is designed to attract large-power industries to Québec or facilitate the expansion of existing industries.

The current Electrotechnology Implementation Assistance Program, launched in 1985, should reach its sales objective of 300 megawatts in June 1988. The purpose of this program is to promote high-performance electric technologies that help to make businesses more competitive. In the next three years, the utility will continue to promote electrotechnologies, and sales under this program could generate $30 million a year.

Deliveries under Hydro-Québec's surplus electricity program will terminate at the end of the contracts now in effect. Most of these contracts expire in 1988. This temporary program was introduced to minimize the destabilizing effects of the large surpluses of recent years. It included financial assistance for the purchase of electric boilers and offered prices significantly below supply costs. Surpluses have now decreased, notably because Québec demand has risen. All remaining surpluses can be absorbed by neighboring systems at prices that are far more advantageous to Hydro-Québec. Henceforth, the utility intends to place greater emphasis on these markets so as to benefit all its Québec customers. Most of the customers in the surplus electricity program will opt for other sources of energy, although some may prefer to take advantage of the dual-energy or interruptible power programs.

In the residential and farm sector, the utility will increase its dual-energy stock in the long term and encourage customers to use their systems in automatic mode with an advantageous rate and appropriate after-sales service. In the general sector, it will continue to offer the dual-energy program in addition to promoting certain other off-peak uses.

Balanced Rates Policy

In the long term, Hydro-Québec intends to keep its rate increases close to the inflation rate. This will enable it to reach a level of profitability that will contribute to an adequate margin of maneuver. But, over a period of several years, it also intends to balance its rates more effectively. The objective is to achieve rates that better reflect the costs incurred to supply each customer category and thus to correct the discrepancies between the various categories.

Québec Markets

OBJECTIVE 1

Maintain personalized relationships with the various customer categories in order to increase customer satisfaction and support efforts to maintain and develop electricity markets.

STRATEGIES

1. Increase contacts with customers and their associations
2. Stress the involvement of Hydro-Québec employees in customer service
3. Revise business practices for supplying electricity
4. Provide increased assistance for commercial and industrial customers
5. Improve communication systems with customers and create a recourse mechanism for dissatisfied customers
6. Improve collection methods as a function of customer needs

OBJECTIVE 2

Maintain and selectively develop Québec markets, in order to offer advantageous options that reflect customers' individual needs and at the same time reduce the cost of supplying electricity.

STRATEGIES

1. Promote the use of electricity by the industrial sector:
    - promote risk and profit sharing
    - continue to promote electrotechnologies
    - attract foreign companies to Québec
2. Promote off-peak consumption:
    - increase interruptible power stock
    - maintain and expand the residential dual-energy stock
    - attract surplus electricity customers to the dual-energy program
    - continue the remote control pilot project in the residential sector

OBJECTIVE 3

Keep overall rate increases close to the projected inflation rate. Increases should be adjusted so that they gradually reflect the costs of supply, create a sufficient margin of maneuver to assure the utility's financial equilibrium and support the development of profitable markets.

STRATEGIES

1. Recommend a rate increase for 1988 based on the principles set out in objective 3 (this recommendation is discussed in a supplement entitled Mémoire sur la tarification proposée pour 1988); an average annual increase of 4.5% has been assumed for 1988-1990
2. Offer rate options for off-peak consumption

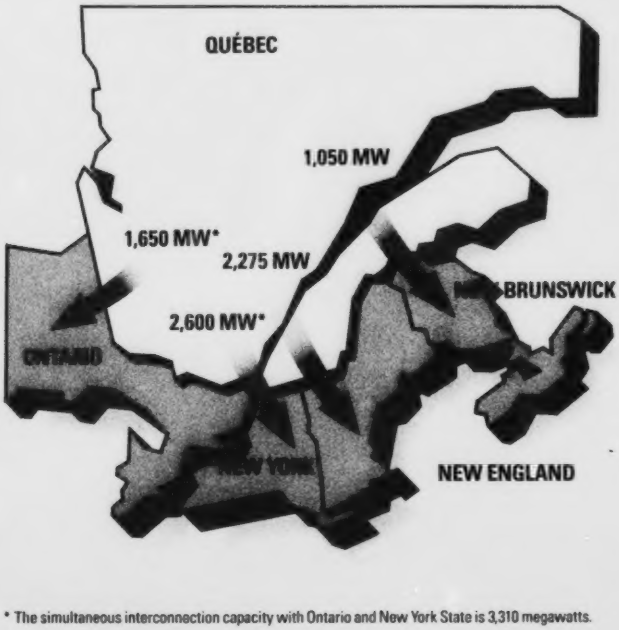
External Markets: The Advantage of Firm Electricity

In addition to its sales of surplus electricity, Hydro-Québec intends to achieve a lasting breakthrough on export markets. Since 1983, it has been developing a three-stage strategy. During the first stage, the objective is to maximize revenue from the sale of surpluses generated by existing facilities. The objective of the second and third stages is to sell large blocks of firm power and energy, thus entailing earlier commissioning of certain facilities.

First Stage

The development of surplus electricity markets, which began early in the 1980s when the growth of Québec demand dropped off, is almost complete. Hydro-Québec increased its export sales by 50% from 1983 to 1987, and thus disposed of a major portion of its surpluses. The utility had to increase the capacity of its interconnections but did not advance the commissioning date of any major generating facilities. Today, Hydro-Québec can maximize the remaining surpluses by selecting the best markets. Replacing oil-fired generation on neighboring systems is the most attractive option.

MAP 1
INTERCONNECTIONS WITH NEIGHBORING SYSTEMS IN 1990



* The simultaneous interconnection capacity with Ontario and New York State is 3,310 megawatts.

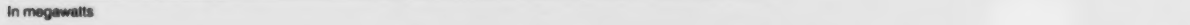
Second Stage

In the longer term, instead of selling surpluses, the utility intends to sell firm power and energy to replace new base-load generation on neighboring systems. Neighboring systems are in a position where they must shortly make major decisions as to how to meet their needs in the 2001 horizon. Hydro-Québec is negotiating contracts that make imported electricity more attractive than the construction of new generating stations. The objective is deliveries of 3,500 megawatts in the 2001 horizon. The revenue per kilowatthour that Hydro-Québec will derive from these contracts will be greater than that obtained from its Québec customers. What Hydro-Québec wants to ensure is that it achieves a level of profitability equal to shareholders' requirements in the private sector for comparable projects.

These sales will require only minor additions to the existing interconnections. Moreover, as contracts are signed, Hydro-Québec will advance the commissioning dates of generating facilities that would only be required later for Québec's needs. Thus far, Hydro-Québec has entered into three agreements with utilities in Maine, Vermont and New York totaling 2,400 megawatts, or nearly 70% of its objective of 3,500 megawatts.

FIGURE 5
SATISFACTION OF PROJECTED NEEDS ON NEIGHBORING SYSTEMS

(medium-demand scenario)



Third Stage

The third development stage requires no decisions in the short term because its objective is to meet the needs of neighboring systems after the year 2001. The export prospects for this stage are substantial, but these sales will require the development of additional interconnections on a large scale. In this stage, as in the second stage, it will be necessary to advance the construction dates of large-scale generating and transmission facilities. For these projects, Hydro-Québec is developing innovative financing that will contain an element of risk sharing.

TABLE 2
HYDRO-QUÉBEC'S TOTAL SALES OF ELECTRICITY

(in terawatthours)

	1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Québec sales												
• Firm	103.5	110.4	115.9	120.5	125.1	129.0	132.1	136.0	139.6	144.7	147.7	151.3
• Surplus	13.7	13.7	11.4	2.2	0.4	-	-	-	-	-	-	-
Sub-total	117.2	124.2	127.3	122.8	125.5	129.0	132.1	136.0	139.6	144.7	147.7	151.3
Export sales												
• Firm	7.0	8.3	8.0	8.3	10.3	14.9	16.4	16.5	14.5	19.1	22.8	22.8
• Surplus	19.9	20.5	16.0	14.8	13.2	9.6	5.5	4.0	-	-	-	-
Sub-total	26.9	28.8	23.9	23.1	23.5	24.5	21.9	20.5	14.5	19.1	22.8	22.8
Total sales	144.1	152.9	151.2	145.9	149.0	153.4	153.9	156.5	154.1	163.9	170.5	174.1

External Markets

OBJECTIVE 1

Maximize revenue from sales of existing surpluses.

STRATEGIES

1. Adjust prices to reflect changes in market conditions and surpluses
2. Increase the price of surpluses by guaranteeing annual quantities or making energy available during peak periods on neighboring systems
3. Optimize the use of existing interconnections

OBJECTIVE 2

Consolidate the breakthrough on export markets by continuing negotiations with neighboring systems for the sale of firm power and energy totaling 3,500 to 4,500 megawatts.

STRATEGIES

1. Continue negotiations for the sale of firm power and energy
2. Plan the necessary interconnections, taking environmental requirements into account

OBJECTIVE 3

Pursue the sale of firm power and energy to neighboring systems over and above the amounts forecast in the second stage of development.

STRATEGIES

1. Establish price formulas and sales conditions adapted to the market
2. Investigate innovative financing
3. Evaluate the feasibility of delivering large additional quantities of electricity
4. Continue discussions with neighboring systems in order to conclude new contracts
5. Intensify promotional activities aimed at Canadian and U.S. agencies

3. THE CHALLENGE OF THE POWER SYSTEM

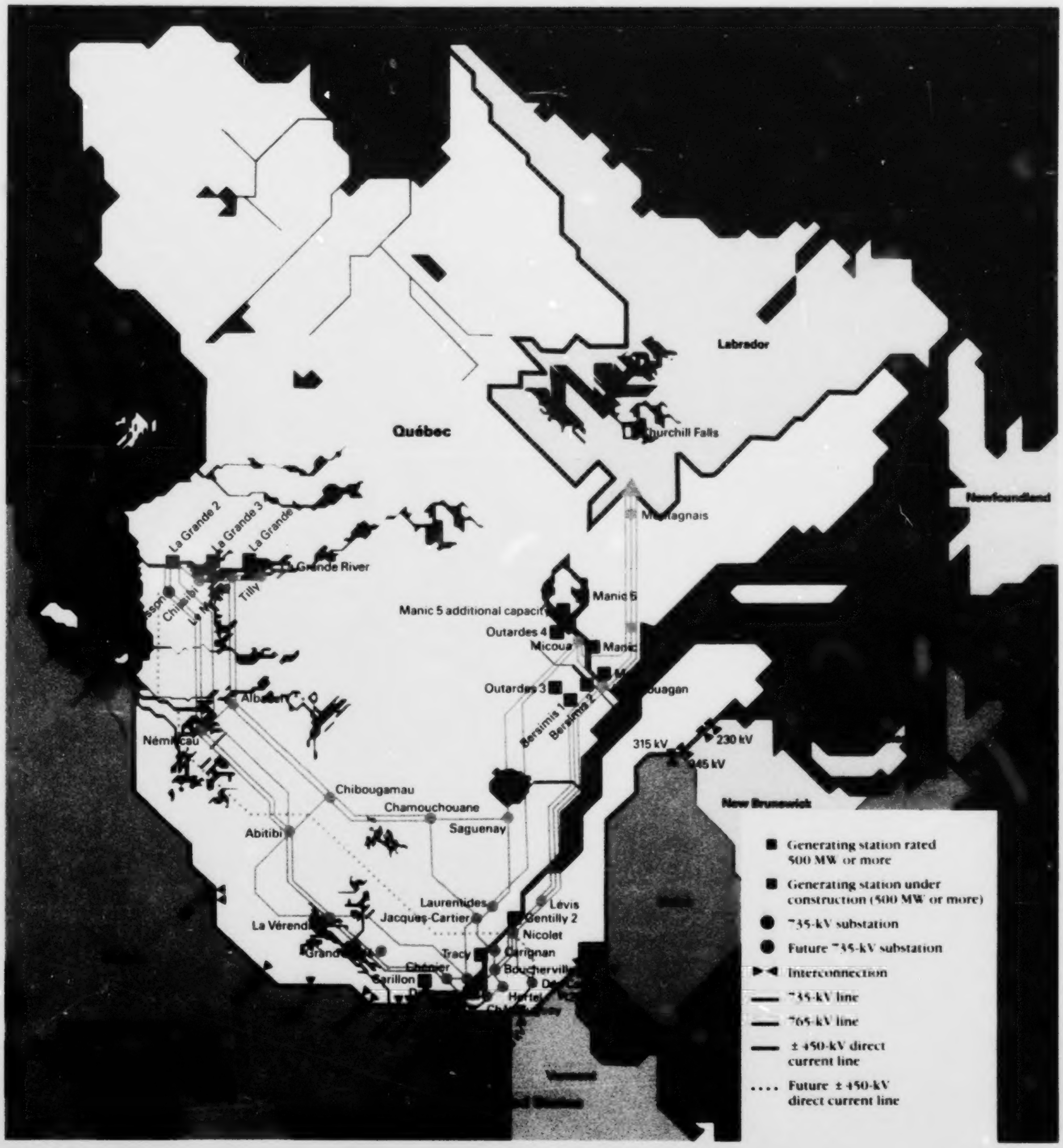
. . . .

Hydro-Québec's generating and transmission facilities will meet its needs for several years. The utility has 80 generating stations with installed capacity of 24,533 megawatts and access to about 4,300 megawatts from Churchill Falls. The system also includes ten 735-kilovolt transmission lines with a combined length of nearly 10,000 kilometres. Two peak-load generating stations, additional capacity at Manic 5 and La Grande 2, and a 450-kilovolt direct current line are now under construction.

With the existing facilities, improvements to them and the additional capacity referred to above, the utility will be able to meet demand until 1994. Accordingly, Hydro-Québec does not foresee the need for any other generating facilities before 1995. Until then, in addition to preparing for the commissioning of these new plants, the utility will also give priority to operating its existing facilities as profitably as possible.

Map 2

HYDRO-QUÉBEC'S GENERATING AND TRANSMISSION SYSTEM


Labrador
Québec
Churchill Falls
Newfoundland
Montagnais
La Grande 2
La Grande 3
La Grande
Grande River
Chissibi
Tilly
Manic 5
Manic 5 additional capacity
Outardes 4
Micoua
Manic
Outardes 3
Bersimis 1
Bersimis 2
Manicouagan
315 kV
230 kV
345 kV
New Brunswick
Némiscau
Albanel
Chibougamau
Chamouchouane
Saguenay
Abitibi
Laurentides
Lévis
Jacques-Cartier
Gentilly 2
Nicolet
La Vérendrye
Tracy
Carignan
Chénier
Boucherville
Carillon
Hertel
Vermont
New Hampshire
Generating station rated 500 MW or more
Generating station under construction (500 MW or more)
735-kV substation
Future 735-kV substation
Interconnection
735-kV line
765-kV line
± 450-kV direct current line
Future ± 450-kV direct current line

Improvements to Existing Facilities

Today, almost 20% of Hydro-Québec's installed hydroelectric capacity is more than 30 years old; in 2006, this percentage could rise to 30%. The aging of these facilities will therefore be an increasingly important problem. The utility has already begun taking measures to alleviate this situation.

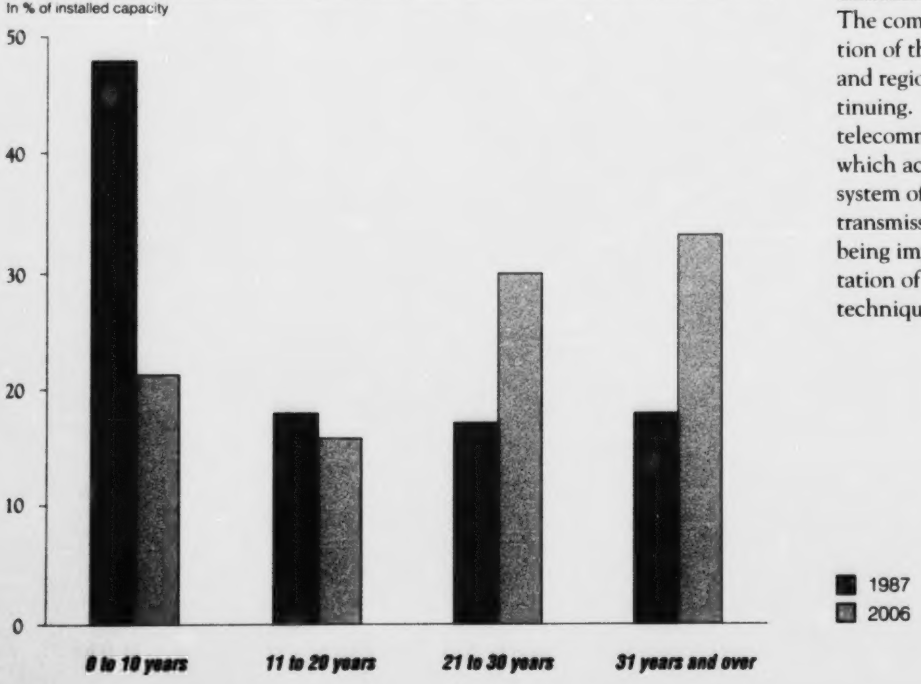
Large investments will continue to be made in the transmission and sub-transmission system, which has been significantly improved in recent years as a result of the service quality enhancement program.

In addition, some $600 million will be invested between 1988 and 1992 for the implementation of new transmission system design criteria. These criteria will improve system performance by considerably reducing the likelihood of a general power failure.

The distribution system has also been strengthened since 1984 under the service quality enhancement program. As a result of this program, outages and interruptions for maintenance decreased by 10% between 1984 and 1987. In the years to come, Hydro-Québec will continue to improve continuity of service in several ways, including pilot projects for on-line remote control of disconnection points and customer-demand management by remote control, and further automation of distribution. It is also studying various options for the design of future underground systems.

System control involves maintaining a constant balance between electricity supply and consumption in conditions of optimum safety, reliability and economy. To ensure efficiency, the utility has turned to large-scale automation of this crucial function. The computerization and automation of the System Control Centre and regional control centres is continuing. At the same time, the telecommunications network, which acts as the central nervous system of the generating and transmission system, is gradually being improved with the implementation of a new data transmission technique developed by the utility.

FIGURE 6
AGE OF HYDROELECTRIC GENERATING FACILITIES



Existing Facilities

OBJECTIVE 1	STRATEGIES
Improve the continuity and quality of electricity service.	1. Complete the service quality enhancement program 2. Continue the pilot project for the remote control of strategic disconnection points on the distribution system 3. Continue the installation of distribution control centres 4. Implement new transmission design criteria to improve performance by reducing the risk of a general power failure

OBJECTIVE 2	STRATEGIES
Increase maintenance efficiency, taking into account its impact on the utility's revenue from sales of electricity, the safety of employees and the public, operating requirements and technological developments.	1. Plan long term upgrading or replacement of facilities 2. Improve the availability of existing facilities by re-evaluating design and maintenance practices 3. Automate maintenance management and develop new automated tools to improve quality of service and employee safety 4. Standardize the work methods of Hydro-Québec's employees and outside partners with respect to safety

OBJECTIVE 3	STRATEGIES
Increase the profitability of power-system operations.	1. Systematically evaluate new ways of increasing generation and delivery of electricity 2. Computerize and automate the regional control centres and the System Control Centre to a greater degree 3. Complete the installation of remote controls in all regional control centres 4. Adapt system control as a function of dual-energy and interruptible power programs

New Facilities: Toward Greater Flexibility

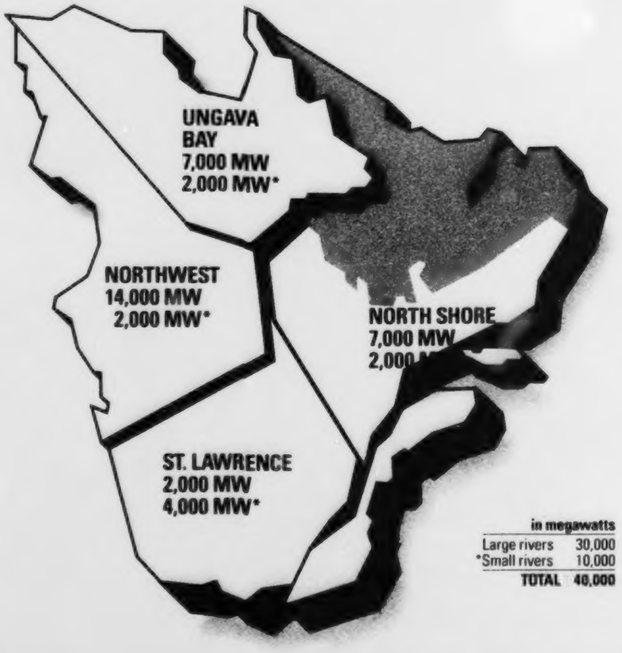
Considerable Hydroelectric Potential

Hydro-Québec will need additional facilities beginning in 1995 in order to meet its energy and power requirements. As there is no shortage of rivers to develop, it has access to considerable undeveloped hydroelectric potential. In fact, the undeveloped potential (approximately 40,000 megawatts) is greater than that which has already been developed (22,800 megawatts).

Large undeveloped rivers represent about 30,000 megawatts, of which 18,000 could be developed more economically than any other option for generating electricity, be it nuclear, oil-fired or coal-fired. Most of the 18,000 megawatts that can be developed economically is located in the James Bay and Hudson Bay area in the Northwest region of the province.

The potential of small rivers is also far from negligible: about 10,000 megawatts on more than 400 rivers remains to be developed. Hydro-Québec is studying the possibility of developing some of these rivers for its unconnected

Map 3
QUÉBEC'S UNDEVELOPED HYDROELECTRIC POTENTIAL



	in megawatts
Large rivers	30,000
*Small rivers	10,000
TOTAL	40,000

power systems, on which this output could advantageously replace generation from diesel stations. It will also purchase electricity from small generating stations that would be constructed and operated by independent producers.

To transport the 18,000 megawatts considered the most economical, eight new 735-kilovolt alternating current transmission lines will be required, six from the Northwest and two from the North Shore.

Projects to add capacity at Manic 5 and La Grande 2 are now under way and will be completed in 1989 and 1992-1993, respectively.

Commissioning of the Radisson-Nicolet-Des Cantons direct current line, the 11th line of the transmission system, is scheduled for 1990.

Target Program and Alternative Scenarios

The target construction program, with forecast exports of 3,500 megawatts, calls for the development of approximately 10,000 megawatts of generating capacity between 1995 and 2006. According to this program, 16 new generating stations will be commissioned, as well as four new 735-kilovolt alternating current transmission lines. Because of exports, some of the facilities will be commissioned earlier than they would have been, had they been required to meet Québec demand alone.

The first facilities scheduled for this program are those related to Phase II of the La Grande Complex. La Grande 1 and Brisay would be commissioned in 1995 and 1996, as indicated in the target scenario of last year's plan. But, as the Québec demand forecast has been revised upward for the early 1990s, the commissioning of Laforge 1 has been advanced from 1997 to 1995. The 12th 735-kilovolt alternating current line will be commissioned in 1995, as scheduled. The 13th line, which would be used beginning in 1995 to transport additional capacity from

FIGURE 7
EARLIER CONSTRUCTION SCHEDULE FOR EXPORTS OF 3,500 MW

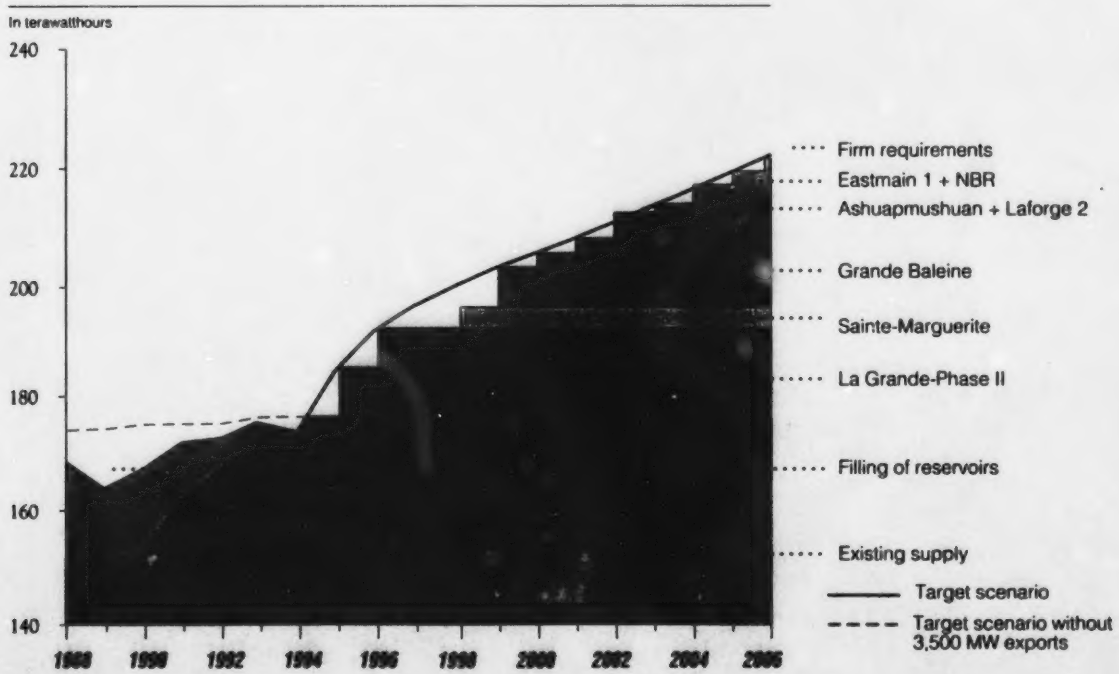


TABLE 3
COMMISSIONING DATES FOR THE TARGET CONSTRUCTION PROGRAM

	Maximum power at peak (in megawatts)	**Commissioning date**		
Projects in progress				
• Manic 5 A	1,056	1989		
• La Grande 2 A	1,900	1992-1993		
• 11th 450 kV DC line Radisson - Nicolet - Des Cantons		1990		
		Target scenario +2.7% in Québec and 3,500 MW exports	**Strong-demand scenario +3.3% in Québec and 3,500 MW exports**	**Weak-demand scenario +1.9% in Québec and 3,500 MW exports**
Future projects				
La Grande - Phase II				
• La Grande 1	1,296	1995-1996	1994-1995	2000-2001
• Laforge 1	783	1995	1995	2004
• Brisay	385	1996	1995	2004
• 12th line: 735 kV AC		1995	1994	2000
North Shore				
• Manic 5 and 3 turbine runners	248	1995	1995	1996
• Additional capacity for Manic 3, 2 and 1	1,042	1997-2000	1995-2003	1998-2000
• Sainte-Marguerite	822	1998	1998	*
• 13th line 735 kV AC		1995-1998	1995-1998	1996-...
Grande Baleine complex				
• Grande Baleine 1, 2 and 3	2,891	1999-2001	1997-1998	*
• 14th line: 735 kV AC		1999	1997	*
Ashuapmushuan complex	550	2002-2003	1998	*
Northwest				
• Laforge 2	270	2003	1996	*
• Eastmain 1	510	2004	1996	*
• Nottaway-Broadback-Rupert	8,700	2004-...	1997-...	*
• 15th line: 735 kV AC		2004	1998	*
Other peak-load plant	372	2005		

* Commissioning after 2005

the Manicouagan Complex, will be extended in 1998 to Sainte-Marguerite generating station.

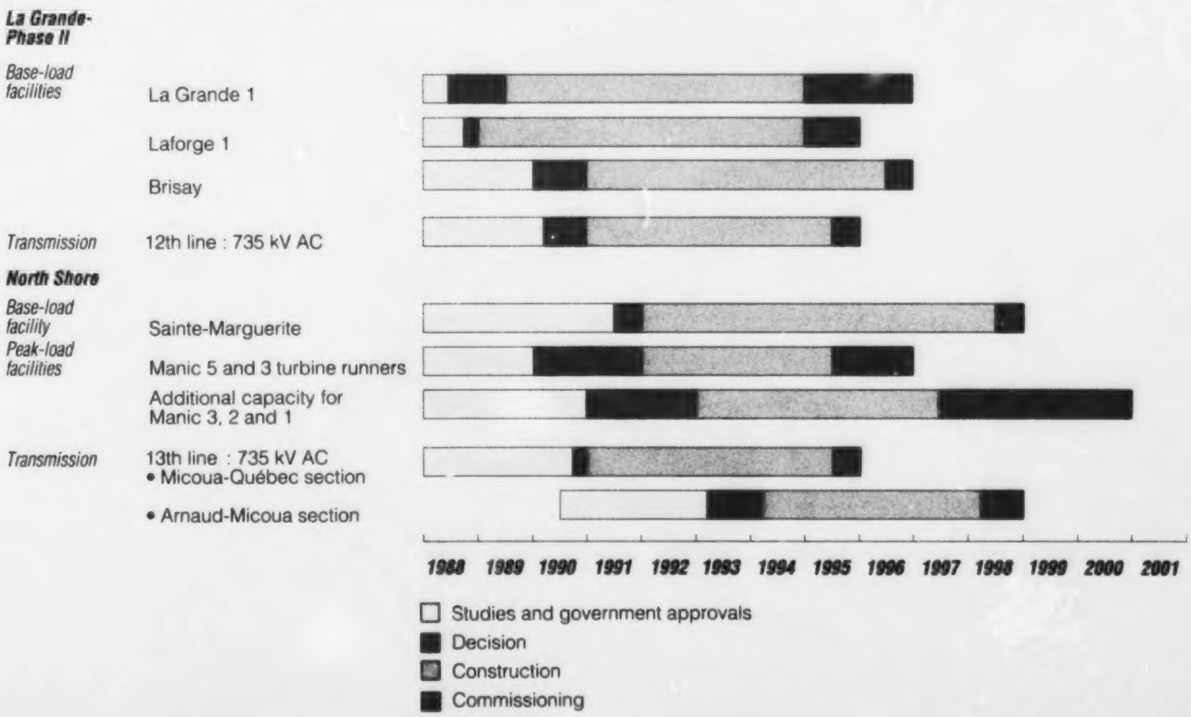
According to the target scenario, sales of firm electricity in Québec will increase by 2.7% a year from now until 2006. Two other scenarios have been retained, however: the high-growth scenario forecasts annual growth of 3.3%, the low-growth scenario, growth of only 1.9%. Hydro-Québec will have to ensure that it is flexible enough to react quickly to changing market conditions. For instance, if Québec demand rises sharply, the utility could commission La Grande 1 one year earlier than in the target scenario, that is, in 1994-1995 rather than 1995-1996.

Preparations for the construction of the first base-load facilities scheduled are well under way. Hydro-Québec has already completed the studies for La Grande 1, Laforge 1 and Brisay (the three projects related to La Grande - Phase II) and it intends to begin obtaining government authorizations as of 1988. It has also begun studies for the 12th alternating current line.

In 1988, the utility will have to continue studies for projects to add capacity to the Manicouagan Complex so that it can begin commissioning these facilities in 1995. Preliminary project studies will also continue in 1988 for Sainte-Marguerite, which is scheduled for commissioning in 1998. As well, studies on the 13th alternating current line from the North Shore began in 1987.

From now until 1997, generating and transmission projects, as well as upgrading work, will represent investments of $28 billion.

FIGURE 8
DECISION TIMETABLE - TARGET SCENARIO



Power System Development

OBJECTIVE

Plan Hydro-Québec's generating facilities and transmission system to satisfy contractual commitments and provide the flexibility needed to adjust rapidly to market conditions, while making rational use of water resources.

STRATEGIES

1. Commission additional capacity at Manic 5 in 1989
2. Commission additional capacity at La Grande 2 in 1992-1993
3. Complete work for decisions regarding generating and transmission facilities in order to finalize development strategies for Québec and external markets:
   - starting in 1988, obtain all government authorizations for the construction of Phase II of the La Grande Complex
   - continue studies on the generating and transmission facilities required after Phase II of the La Grande Complex

Environmental Protection

Hydro-Québec is aware that its activities have important repercussions for the environment. The environmental disturbances and concerns are varied: the use of contaminants, chemical control of vegetation, noise emitted by certain substations, the design of components in the overhead distribution system, reservoir management and multi-purpose use of sites.

For several years, Hydro-Québec has been taking measures to protect or restore the environment. For example, it adopted a polychlorinated biphenyls (PCBs) action plan in 1986 to ensure safe management and elimination of PCBs within 10 years.

The utility has adopted three main strategies to integrate environmental concerns into the project planning process as early as possible. It has begun carrying out preliminary studies in two distinct phases, in order to improve consultation with other land-use planners and developers and the general public. It maintains its environmental follow-up efforts: after construction, it analyzes the real impacts of facilities. It is also continuing an examination, begun in 1987, of the cumulative environmental impacts of all facilities in the construction program. This comprehensive approach should enable Hydro-Québec to improve the planning, construction and operation of facilities, while maintaining the utmost respect for the environment.

Environmental Considerations

OBJECTIVE 1

Continue present efforts to ensure the protection and enhancement of the environment as part of operating activities.

STRATEGIES

1. Manage the risks associated with polychlorinated biphenyls and identify the risks associated with electric and magnetic fields, contaminants and herbicides
2. Identify environmental enhancement problems related to power system operation

OBJECTIVE 2

Promote the increased use of environmental data at the planning, design and construction stages of generating and transmission facility projects.

STRATEGIES

1. Facilitate consultation by dividing preliminary projects into two phases and advancing the study schedules
2. Use environmental follow-up results to improve mitigative measures
3. Develop a study program on the cumulative environmental impact of the construction program as a whole

4. THE RESOURCES NEEDED TO CARRY OUT THE PLAN

. . . .

In the years to come, Hydro-Québec will face a significant management challenge. In a volatile context that is increasingly difficult to anticipate, the utility will have to manage the three basic components of its activities - its human, technological and financial resources - as efficiently as possible.

Human Resources: A Dynamic Force

Hydro-Québec has come through the crisis of the 1980s effectively, as a result of a number of vigorous measures. The utility has been reorganized, the number of employees reduced and the increases in remuneration slowed. In fact, Hydro-Québec's lead in remuneration over comparable companies was reduced by one-half between 1982 and 1987. But, most important, the utility achieved a significant increase in productivity. With fewer employees than in 1982, it has considerably increased installed capacity, electricity sales and

TABLE 4
POSITIONS AND EMPLOYEES

	1982	***1983***	***1984***	***1985***	***1986***	***1987***	***1988***	***1989***	***1990***
PERMANENT POSITIONS*									
(Authorized at January 1)	20,584	20,631	19,600	19,400	19,350	19,825	19,825	19,825	19,825
Permanent employees*									
(at December 31)	19,959	18,975	18,560	18,208	18,470	18,933	19,264	19,350	19,450
At January 1	19,482	19,959	18,975	18,560	18,208	18,470	18,933	19,264	19,350
Hired during the year**	802	146	217	595	487	685	656	381	400
Departures during the year									
• retirement	170	871	501	803	114	132	200	170	150
• other	155	259	131	144	111	90	125	125	150
Temporary employees***	3,529	1,986	2,186	3,163	2,749	2,989	3,000	3,000	3,000
Operations	2,520	1,610	1,886	2,788	2,326	2,656	2,665	2,665	2,665
Construction sites	521	262	186	195	242	204	205	205	205
Decrees	488	114	114	180	181	129	130	130	130
Management-SEBJ									
(total person-years)	1,366	982	485	200	121	153	197	265	335

* Excludes subsidiaries.
** Includes the return of employees from subsidiaries.
*** Average based on 26 pay periods.

customer accounts, while emphasizing quality customer service. Overall, Hydro-Québec is now doing more with fewer employees.

It will have to pursue this course in order to maintain its competitive edge on the energy markets. Measures taken to increase productivity will, however, have to be more specific and better adapted to each field of activity.

It will be necessary to ensure greater flexibility in allocation of resources, and this may imply adjustments to the planning and performance of tasks. To this end, Hydro-Québec will be concentrating on four main objectives: productivity, training, occupational safety and equal opportunity.

TABLE 5
*BREAKDOWN OF PERMANENT EMPLOYEES-DECEMBER 1987**

Job group ***Administrative units***	***Managers***	***Specialists***	***Engineers***	***Technicians***	***Clerical***	***Trades***	***Constables***	***TOTAL***
Regions								
La Grande Rivière	136	111	32	127	244	420	0	1,070
Laurentides	214	132	39	137	690	807	0	2,019
Maisonneuve	175	153	94	364	268	679	0	1,733
Manicouagan	94	56	24	139	158	418	0	889
Matapédia	69	61	12	66	200	244	0	652
Mauricie	209	126	106	233	413	771	0	1,858
Montmorency	193	138	41	188	578	714	0	1,852
Richelieu	175	118	34	143	568	637	0	1,675
Saguenay	64	38	15	62	126	211	0	516
Saint-Laurent	193	203	40	54	863	642	0	1,995
Total	1,522	1,136	437	1,513	4,108	5,543	0	14,259
• Men	1,476	965	422	1,494	2,045	5,519	0	11,921
• Women	46	171	15	19	2,063	24	0	2,338
Head office	389	1,296	327	104	878	127	116	3,237
Engineering and construction	169	154	208	153	233	2	0	919
IREQ	37	44	163	134	73	67	0	518
Total	595	1,494	698	391	1,184	196	116	4,674
• Men	551	1,141	669	384	351	186	109	3,391
• Women	44	353	29	7	833	10	7	1,283
TOTAL Hydro-Québec	2,117	2,630	1,135	1,904	5,292	5,739	116	18,933
• Men	2,027	2,106	1,091	1,878	2,396	5,705	109	15,312
• Women	90	524	44	26	2,896	34	7	3,621

* Excluding subsidiaries.

Human Resources

OBJECTIVE 1

Continue to improve the productivity of human resources.

STRATEGY

Introduce measures to increase the productivity of specific units or activities

OBJECTIVE 2

Introduce new training programs and adapt those already in place to better respond to the professional development, management training or safety training needs of specific groups of unionized, non-unionized or management employees.

STRATEGIES

1. Improve the process for measuring management performance
2. Develop the skills of managers
3. Ensure the utility's labor relations values are better known
4. Promote the development of clerical employees

OBJECTIVE 3

Improve the utility's industrial accident record.

STRATEGIES

1. Complete the introduction of the new *Work Rules* in 1988 by ensuring adequate training and rigorous application of them
2. Seek agreement from the provincial Trades Health and Safety committee on criteria for live-line work on the distribution system

OBJECTIVE 4

Retain existing equal-opportunity programs and introduce new programs that will achieve the utility's goals.

STRATEGIES

1. Implement a follow-up procedure for quantitative objectives
2. Implement career planning for female non-unionized clerical employees
3. Prepare female employees for management positions
4. Increase representation of women in non-traditional jobs
5. Help introduce day care facilities in the workplace

Technology Serving Development

Technology is vital to Hydro-Québec's activities. Whether improving power system operation and maintenance, developing the transmission system or promoting the use of electricity in industry, the utility must maintain and reinforce its capacity for technological innovation. During the period from 1988 to 1990, it plans to invest about $300 million in technological development activities geared even more closely to its specific needs.

The following orientations have been adopted:

- help reduce the costs of supplying electricity;
- help solve technological problems related to electricity exports;
- contribute to improved quality of service, occupational health and safety, and environmental quality;
- increase sales of electricity by developing and marketing electrotechnologies;
- promote marketing of technology and expertise in Québec, as well as on export markets through the subsidiary Hydro-Québec International;
- promote employee innovation and participation.

Significant developments occurred in 1987. New planning and research-management mechanisms were introduced. The electrochemistry and electrotechnology laboratory (LTEE) began operating in July 1987. In addition, during the year Hydro-Québec introduced an in-house customer-supplier relationship whereby each internal "customer" must finance its own R&D projects, just as outside customers do.

Technology

OBJECTIVE 1

Give priority in orienting technological activities to achieving the utility's major objectives.

STRATEGIES

1. Ensure greater involvement by the utility's main units in the orientation and follow-up of R&D programs and promote the internal use of the products arising from them:
    - introduce new consultation mechanisms and management structures
    - intensify those R&D efforts most likely to be of significance to strategic technological choices
2. Coordinate technological prospecting and exploration efforts
3. Intensify development and demonstration activities for new processes that use electricity

OBJECTIVE 2

Market technological development activities and exploit opportunities for diversification.

STRATEGIES

1. Place greater emphasis on marketing aspects when selecting projects
2. Market know-how and laboratory services while retaining priority for Hydro-Québec's needs
3. Carry out industrial activities in fields using technologies developed by Hydro-Québec

OBJECTIVE 3

Increase the international presence of Hydro-Québec and its partners on financially accessible markets by marketing the expertise in electric utility technology and management for which they are renowned.

STRATEGIES

1. Give priority to those services for which Hydro-Québec has a comparative advantage
2. Concentrate efforts on the most promising markets where project financing is most certain
3. Systematically seek out partnerships with private interests

Financial Management: The Key to Profitability

To carry out its target construction program, Hydro-Québec plans to invest $39 billion over the next ten years. Between 1988 and 1990, investments will be $7.5 billion. The utility will need to borrow close to $3 billion annually and will therefore have to maintain regular access to financial markets. During the same period, interest and exchange loss alone will represent annual expenditure of more than $2.5 billion.

At the same time, Hydro-Québec will have to cope with a changing financial context, several components of which may fluctuate in the years to come. The price of competing forms of energy, for example, affects revenue from electricity sold for dual-energy systems, as well as revenue from export sales. Other variables that affect Hydro-Québec's profitability are interest rates, exchange rates and the general rate of inflation. The utility is therefore pursuing strategies to reduce financing costs and exercise tighter management of financial risks.

TABLE 6
IINVESTMENTS IN THE TARGET CONSTRUCTION PROGRAM
(in millions of current dollars)

Type	**1988**	**1989**	**1990**	**1991-1997**	**Total 10 years**	**%**
Generation	540	726	919	15,416	17,601	45
Transmission	797	862	977	7,820	10,456	27
Distribution	581	533	530	4,906	6,550	17
Support and technology	249	273	326	2,741	3,589	9
Grants, loans, investments and advances	73	66	98	460	697	2
TOTAL	2,240	2,460	2,850	31,343	38,893	100

The events of recent years have shown the degree to which Hydro-Québec is sensitive to changes in the economic and energy context. By choosing to implement strategies to develop its share of Québec and external markets and to reduce costs, the utility has decided to increase its risks in order to achieve a better level of efficiency and profitability in the long term.

These risks are varied in nature. For example, the risk and profit sharing program for certain customers in large-power industries is designed to stimulate Québec's economic growth. But, if the economic situation were unfavorable for several years, these contracts would temporarily be less profitable for Hydro-Québec. The development of external markets on the basis of advanced commissioning of facilities also involves elements of uncertainty, notably the costs of constructing such facilities. Tighter management of reservoirs enables the utility to defer investments, but exposes it to inconvenience at times of exceptionally low runoff. In the long term, floating-rate debt should be less costly than fixed-rate debt, but in certain years the opposite could be true.

The utility is, however, reducing certain risks through other strategies. For example, the development of external markets reduces the exchange risk by creating a better balance of US dollar inflows and outflows. Replacing sales of surplus electricity with sales of firm electricity reduces risks associated with fluctuations of fuel prices.

TABLE 7
PRINCIPAL FINANCIAL RATIOS

	1980	1982	1984	1985	1986	1987	1988	1989	1990
Interest coverage	1.18	1.01	1.10	1.12	1.15	1.25	1.25	1.26	1.30
Capitalization (in %)	25.5	26.1	25.3	24.1	24.0	24.9	25.00	25.00	25.00
Self-financing (in %)	33.8	35.1	34.2	35.7	40.6	41.0	43.08	39.69	35.64
Return on equity (in %)	18.6	15.0	4.7	3.2	4.4	7.0	7.54	7.91	9.95
Profit margin: net income / sales revenue (in %)	30.9	24.6	7.3	4.7	6.4	10.0	10.8	11.3	14.0

TABLE 8
FINANCIAL RESULTS OF TARGET SCENARIO

(in millions of dollars)

	1986		**1987**		**1988**		**1989**		**1990**	
	$	**%**	**$**	**%**	**$**	**%**	**$**	**%**	**$**	**%**
Average rate increase		5.4		4.6		4.5		4.5		4.5
Revenue										
Firm electricity - Québec	3,857	8.9	4,183	8.5	4,526	8.2	4,908	8.4	5,287	7.7
Surplus electricity- Québec	167	-20.1	144	-14.2	137	-4.9	38	-72.3	9	-76.3
Electricity exports	649	-3.6	713	9.9	647	-9.3	648	0.2	687	6.0
Other operating income	61	-11.6	55	-8.3	67	21.8	70	4.5	73	4.3
Total	4,734	5.4	5,095	7.6	5,377	5.5	5,664	5.3	6,056	6.9
Expenditure										
Operations	1,129	-2.9	1,246	10.2	1,358	9.0	1,429	5.2	1,505	5.3
Other	854	8.5	899	5.4	978	8.8	1,044	6.7	1,124	7.7
Total	1,983	1.7	2,145	8.1	2,336	8.9	2,473	5.9	2,629	6.3
Income before interest and exchange loss	2,751	8.2	2,950	7.3	3,041	3.1	3,191	4.9	3,427	7.4
Interest and exchange loss										
Interest	2,259	8.9	2,170	-4.0	2,134	-1.7	2,187	2.5	2,220	1.5
Exchange loss	189	-26.7	272	44.2	324	19.1	363	12.0	360	-0.8
Total	2,448	4.9	2,442	-0.3	2,458	0.7	2,550	3.7	2,580	1.2
Net income	303	45.0	508	68.3	583	14.8	641	9.9	847	32.1
Dividends likely to be declared	0		0		189		275		396	
Expenditure, interest and exchange loss	4,431	3.5	4,587	3.5	4,794	4.5	5,023	4.8	5,209	3.7
Gross interest	2,412	3.9	2,413	0.0	2,458	1.9	2,561	4.2	2,653	3.6
Investment										
Gross investment	1,566	-8.1	1,688	7.7	2,240	32.7	2,460	9.8	2,850	15.9
Less : Interest charged to construction in progress	128	-29.1	192	49.5	278	44.8	347	24.8	409	17.9
Net investment	1,438	-5.6	1,496	4.0	1,962	31.1	2,113	7.7	2,441	15.5
Borrowings										
Net issue of bonds	1,809	-7.3	1,842	1.9	1,744	-5.3	1,887	8.2	2,607	38.2
Less : Redemption of long term bonds	1,050	-14.5	1,541	46.7	873	-43.3	990	13.4	1,347	36.1
Net borrowings	759	4.8	301	-60.2	871	189.4	897	3.0	1,260	40.5

Overall, however, Hydro-Québec's development strategies will involve greater exposure to risk than in the past. Nevertheless, the utility will be in a position to reduce its costs of supply and ensure the efficient development of water resources through dynamic and profitable expansion of Québec and external markets.

Because of this new configuration of risks, in certain years Hydro-Québec may face a combination of reduced revenue and increased expenditure. Accordingly, it must achieve a margin of maneuver that exceeds its minimum financial criteria.

TABLE 9
SENSITIVITY OF 1988 NET INCOME

Parameter	***Variation***	***Variation in net income (in millions of dollars)***
Volume of sales of firm electricity in Québec	+1%	45
Volume of sales of surplus electricity in Québec	+1%	1
Volume of export sales	+1%	6
Rates	+1% as of May 1	27
World price of crude oil	+US$1 per barrel	22
Operating expenditure	+1%	-14
Interest rates	+1%	-21
Exchange rate of Canadian dollar (in US$)	+US$0.01	10
Exchange rate of Canadian dollar against a basket of currencies other than the US$	+1%	14

Even in a year as difficult as 1984, the utility achieved its two basic financial criteria: interest coverage greater than 1.0 and capitalization greater than 25%, and was thus able to pay dividends. During the past three years, however, the margin of maneuver disappeared and no dividends were declared. Moreover, in the past four years, return on equity has been well below the cost of the debt, reaching its lowest level of 3.2% in 1985, before rising to 7.0% in 1987.

The context of increasing uncertainty in which Hydro-Québec operates calls for a two-phase strategy. In the short term, the utility intends to restore the minimum financial criteria, while, in the medium term, it will aim for a financial margin of maneuver by raising all its financial ratios. It will achieve this in three ways: reabsorption of the supply-demand imbalance, which will make it possible to sell electricity, now sold at discounts on surplus energy markets, at prices that better reflect costs of supply; the application of its rates policy, which seeks a return on equity of 13% on Québec markets as a whole; and the implementation of cost-reduction strategies. Without this margin of maneuver, the utility could be forced to increase its rates suddenly or see its financial ratios fall, and this could deprive it of access to borrowings at advantageous rates.

According to the financial framework for Hydro-Québec's target scenario, three essential financial criteria will reach their minimum levels in 1988. Interest coverage will be maintained at more than 1.0 and the level of self-financing at 30%. The capitalization ratio will reach its minimum level of 25% during 1988. The return on equity is forecast to reach the average cost of the debt early in the 1990s.

Financial Resources

OBJECTIVE 1

Minimize financing costs and exercise tighter control of financial risks, in order to reduce their impact on the utility's results, rates and dividends.

STRATEGIES

1. Maximize financing in Canadian funds and use other means to minimize exchange risks
2. When negotiating debt, give preference to terms of 10 years or longer
3. Renegotiate outstanding debt when it is advantageous to do so
4. Gradually increase floating-rate debt
5. Examine methods to stabilize the cost of debt service in the short term

OBJECTIVE 2

In the first stage, between now and the end of 1988, restore or maintain three of the four traditional minimum financial criteria: interest coverage equal to or greater than 1.0; capitalization equal to or greater than 25%; self-financing equal to or greater than 30%.
In the second stage, restore a margin of maneuver by achieving the traditional criterion of a return on equity greater than the cost of the debt and by improving all ratios to better counteract the utility's risks.

STRATEGIES

1. Continue cost-reduction efforts
2. On export markets, seek to maximize sales revenue associated with surpluses, as well as the profitability of new contracts, taking risks into account
3. Establish rates that more closely reflect the average cost of supply and ensure a return on equity greater than the cost of the debt

5. COHESIVE STRATEGIES

. . . .

Hydro-Québec's objectives reflect the expectations of its partners, that is, its customers, the Government as its shareholder, and its lenders. To achieve these objectives, the utility has developed a series of interrelated strategies that form a cohesive whole.

Reducing the cost of electricity supply is central to the goal of maintaining the competitive edge of Québec hydroelectricity. Several of the utility's strategies help to reduce costs: supply management; demand management; technological development; debt management; and increased productivity of human resources. The advantages of reduced supply costs are in turn reinforced by various strategies that promote the expansion of Québec and external markets: risk and profit sharing, promotion of electrotechnologies and three-stage development of exports.

The strategies form a balanced whole, with the various components reinforcing one another. Some of Hydro-Québec's objectives may appear contradictory, however, and thus entail certain compromises.

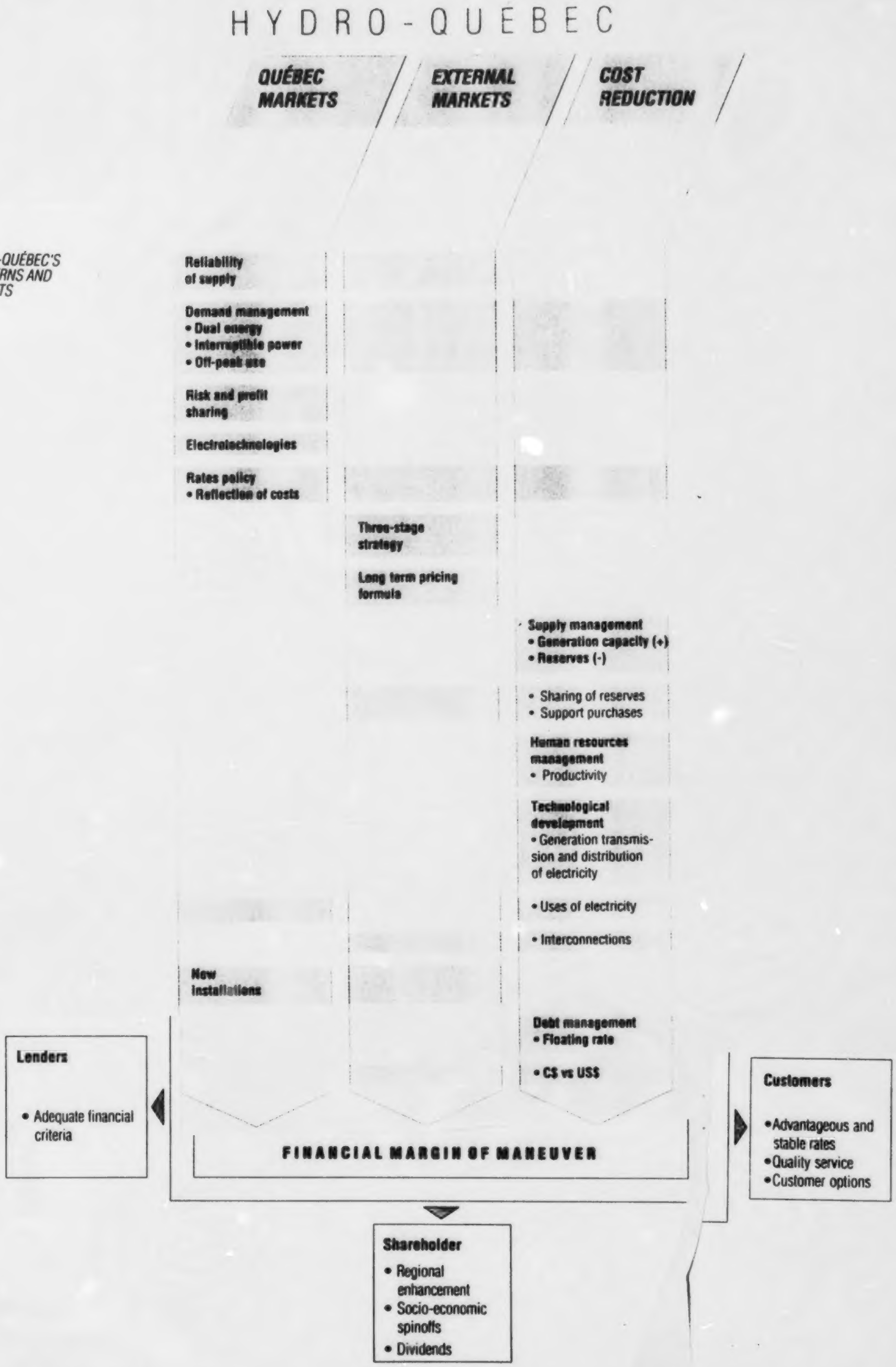
The utility's rates policy is a major factor in determining the degree to which it can satisfy its partners and it is therefore central to these compromises. First, the rates policy is the result of a balance between the search for the best price signal to guide customers in their choices and the desire to keep rate increases as low as possible. The disparities between the various rate categories are considerable, however. In order to transmit a fair and equitable price signal, the rates policy aims to gradually reflect the average cost of supply associated with each customer category in order to distribute this cost more equitably among the various categories.

The second compromise involves rate levels and stability. Hydro-Québec could keep rates artificially low in the short term. But this measure would stimulate consumption of electricity, increasing the costs of supply in the long term and thus reducing the financial margin of maneuver needed to ensure stable rates.

The third compromise involves determining what share of the economic advantages of hydroelectricity is passed on to customers through advantageous rates, and what share is passed on to society as a whole in the form of dividends. It is necessary to establish a fair balance between the interests of customers and those of society as a whole by ensuring the requirement of a rate of return comparable to the returns allowed other public utilities and compatible with the risks incurred.

The fourth compromise involves deciding whether to give priority to short or long term economic spinoffs. In the short term, Hydro-Québec's cost-reduction strategies, which are intended to maintain advantageous rates for customers, decrease the economic benefits to companies and individuals engaged in power-system construction. In the long term, however, these strategies make it possible to keep the price of Québec hydroelectricity competitive and to develop lasting external markets, thereby creating new construction projects.

FIGURE 9
LINKS BETWEEN HYDRO-QUÉBEC'S STRATEGIES, ITS CONCERNS AND THE EXPECTATIONS OF ITS PARTNERS


HYDRO-QUEBEC
QUÉBEC MARKETS
EXTERNAL MARKETS
COST REDUCTION
Reliability of supply
Demand management
• Dual energy
• Interruptible power
• Off-peak use
Risk and profit sharing
Electrotechnologies
Rates policy
• Reflection of costs
Three-stage strategy
Long term pricing formula
Supply management
• Generation capacity (+)
• Reserves (-)
• Sharing of reserves
• Support purchases
Human resources management
• Productivity
Technological development
• Generation transmission and distribution of electricity
• Uses of electricity
• Interconnections
New installations
Debt management
• Floating rate
• C$ vs US$
FINANCIAL MARGIN OF MANEUVER
Lenders
• Adequate financial criteria
Customers
• Advantageous and stable rates
• Quality service
• Customer options
Shareholder
• Regional enhancement
• Socio-economic spinoffs
• Dividends

6.

MAJOR ECONOMIC SPINOFFS

Job Creation

Hydro-Québec's development plan will have major economic spinoffs. After decreasing for several years, investment will rise to the level of a decade ago. Over the next three years, the utility will invest more than $7.5 billion. This should allow Hydro-Québec to maintain a team of nearly 22,500 permanent and temporary employees for construction and operations, in addition to sustaining, on average, an equivalent number of jobs with Québec outside contractors and suppliers. Gross investments will rise to $4.5 billion a year for the period from 1991 to 1997.

Hydro-Québec's marketing programs focus on large-power sectors, which will require nearly 10,500 person-years of work annually from now until 1990. From 1988 to 1990, Hydro-Québec's activities will sustain 58,000 person-years of work annually, of which more than 60% will involve people who are not employees of Hydro-Québec.

TABLE 10
DEVELOPMENT LEVERS AND JOB CREATION

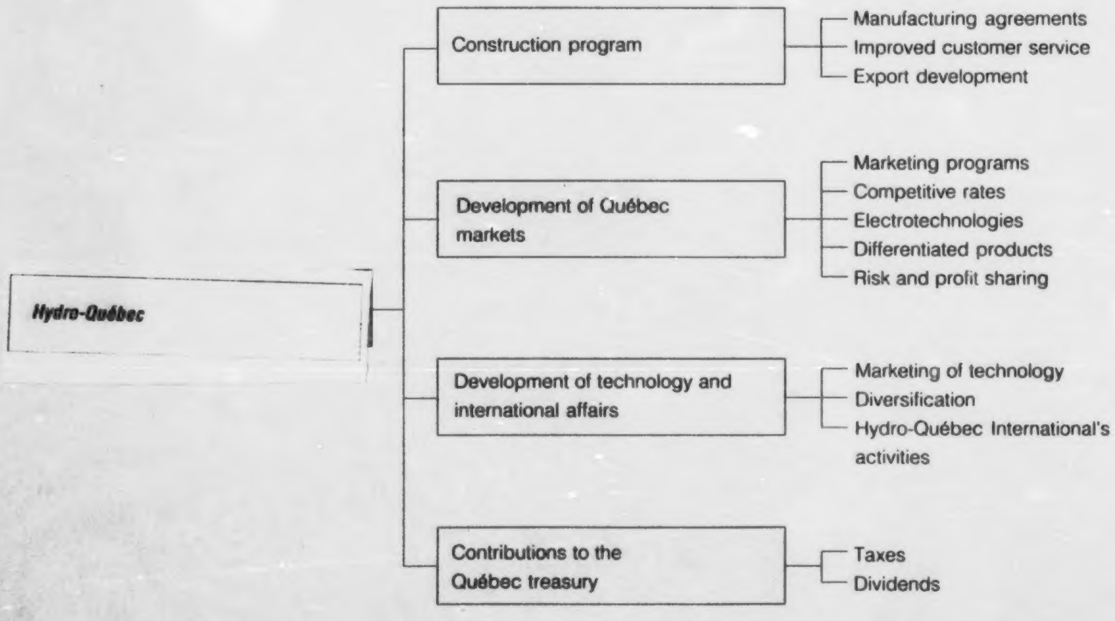

Hydro-Québec
Construction program
Manufacturing agreements
Improved customer service
Export development
Development of Québec markets
Marketing programs
Competitive rates
Electrotechnologies
Differentiated products
Risk and profit sharing
Development of technology and international affairs
Marketing of technology
Diversification
Hydro-Québec International's activities
Contributions to the Québec treasury
Taxes
Dividends

TABLE 11
JOBS SUSTAINED BY HYDRO-QUÉBEC

(in person-years)

	1986*	1987	1988	1989	1990
Generation, transmission and distribution of electricity					
Jobs related to operations	19,990	22,395	23,135	23,350	23,390
• Direct	15,570	15,680	16,170	16,320	16,380
• Indirect	4,420	6,715	6,965	7,030	7,010
Jobs related to capital investments	15,775	17,185	21,725	22,040	23,540
• Direct	8,265	8,515	10,190	10,305	11,015
• Indirect	7,510	8,670	11,535	11,735	12,525
Total	35,765	39,580	44,860	45,390	46,930
Marketing of electricity					
Jobs related to marketing programs	10,580	4,220	3,785	1,690	770
• Dual-energy	1,775	710	125	210	280
• Electrotechnologies	360	400	195	465	465
• Rate discounts	8,100	3,045	3,440	990	0
• Other	345	65	25	25	25
Jobs related to rate advantages for large-power industries	11,615	7,845	9,100	11,220	11,030
Total	22,195	12,065	12,885	12,910	11,800
TOTAL	57,960	51,645	57,745	58,300	58,730

* Revised figures for 1986.

Contributions to Québec Treasury

Hydro-Québec contributes to Québec's development by paying large amounts to the Government each year. Nevertheless, given the financial shocks the utility has had to absorb in recent years, it has not paid dividends since 1985. It plans to declare dividends between 1988 and 1990, however, in addition to the more than $330 million a year it will pay in taxes.

TABLE 12
DIRECT CONTRIBUTIONS TO QUÉBEC TREASURY

(in millions of current dollars)

	1986	***1987***	***1988***	***1989***	***1990***
Taxes	272	289	310	329	347
Dividends	0	0	189	275	396
TOTAL	272	289	499	604	743

Land-use Development

In recent years, Hydro-Québec has undertaken to improve mechanisms for consultation and dialogue with the various other land-use planners and developers. Under a program financed by the utility, agencies whose land is affected by new construction projects may carry out environmental enhancement (creating parks, restoring wildlife habitats, etc.). Hydro-Québec is also continuing efforts to collaborate on multi-purpose land uses, such as bicycle paths on its rights-of-way.

The Québec farmers' association, Union des producteurs agricoles (UPA), has had a special relationship with Hydro-Québec for many years now, as most of the utility's transmission and subtransmission facilities are on farmland or in woodlands. The creation, in 1987, of a permanent forum for cooperation with UPA ensures that productive exchanges will continue. In addition, the utility is continuing a dialogue with various Native groups whose lands are affected by its projects. In 1987, more than $110 million was paid to the Cree under the *La Grande Agreement*, of which $50 million is for the Cree community fund and $45 million for the Cree economic development fund.

7. SERVING ITS PARTNERS AND QUÉBEC AS A WHOLE

. . . .

For Hydro-Québec, 1987 marked the beginning of a financial recovery. Assisted by the strong showing of the Québec economy and the Canadian dollar, the utility's profitability improved for the second consecutive year. The challenge facing it today is to optimize the operation of its existing facilities and gradually add to them, as Québec demand rises and contracts are signed with neighboring systems.

The utility's overall strategy is based on improved productivity and optimized supply and demand management, combined with vigorous marketing activity consistent with rates and quality-of-service policies that seek to satisfy the expectations of its various partners. Hydro-Québec intends to restore a satisfactory level of profitability as soon as possible and to achieve a margin of maneuver that will allow it to absorb external shocks without having to impose abrupt rate increases on its customers. This comprehensive strategy, supported by dynamic technological development, enables Hydro-Québec to fulfill its role as an instrument of economic development, and thus benefit all its partners and Québec as a whole.

Hydro-Québec Development Plan 1988-1990
Horizon 1997

. . . .

Unabridged version

March 1988

The cover photographs show the Broadback Falls in the James Bay region, and the System Control Centre in Montreal.

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Note to Readers

Unless otherwise indicated, the data in this document are those of Hydro-Québec.

Symbols for Units of Measurement

kV - kilovolt (unit of voltage)
kWh - kilowatthour (unit of energy)
GWh - gigawatthour, or 1 million kilowatthours
TWh - terawatthour, or 1 billion kilowatthours
MW - megawatt (unit of power)

1. INTRODUCTION

. . . .

This plan is addressed to Hydro-Québec's shareholder, principal partners and collaborators. It explains the utility's orientations, objectives and strategies and seeks to elicit concerted effort in the development of the advantages that hydroelectricity offers Québec.

Although the plan covers a 10-year horizon, it focuses on activities to be undertaken in the first three years. In the short term, Hydro-Québec will be concentrating on consolidating the measures it began implementing in 1982 in order to restore the financial health of the utility.

The orientations and strategies adopted for the medium and long term are essentially the same as those in the previous plan. Moreover, as in the past, several development scenarios have been prepared. They offer different paths to be explored and emphasize their interaction with the main components of the external context in which Hydro-Québec operates. These components are economic growth, market potential, energy prices, the Canadian dollar exchange rate, interest rates and inflation. Still, these scenarios are only projections: they shed light on the choices available to the utility and define the conditions under which these choices can be implemented, but they offer no certainty as to the path to be followed. Changes in the context may modify the underlying assumptions and require a revision of the strategies and actions to be taken. The uncertain economy, the Canadian dollar exchange rate and the price of oil are good examples of the risks to which the utility is exposed.

The plan begins with a **review** of the action taken in recent years and a description of the **external context**. It looks at marketing activities in Québec and the **target demand for electricity** that results. And it examines strategies for development on **external markets**. It then turns to the **operation and development of installations**. It also presents Hydro-Québec's prospects for developing **technology** and **international affairs**. **Human resources management**, **financial management** and the **financial framework** for 1988-1990 are then discussed. The plan concludes with a discussion of the impact of the **strategies on Hydro-Québec's partners**.

2. REGAINING AN EQUILIBRIUM

. . . .

The results and the scope of the activities undertaken by Hydro-Québec in recent years cannot be appreciated unless they are seen in the context of its overall development. The 1980s marks a transition between a period when the demand for electricity in Québec grew at an annual rate of 7% and the 1990s, when demand is expected to grow at 2 to 3% a year.

During the first phase of its development, which lasted until the early 1980s, Hydro-Québec's activities were based mainly on a succession of plant commissionings required to meet rapidly growing demand. Because of the quality of the sites developed, major economies of scale and the substantial rate increases obtained between 1975 and 1982, the utility achieved a high rate of profitability.

The early 1980s, however, saw a profound imbalance between electricity supply and demand, a problem which was compounded by the 1981-82 recession. This recession, the worst in more than 50 years, caused Hydro-Québec's financial situation to deteriorate. The decline in the value of the Canadian dollar and the drop in the price of oil accentuated this weakness, the one by increasing the cost of debt service and the other by reducing the prices for surplus energy, which had become abundant. To adapt, Hydro-Québec acted on its financial commitments, expenditure and revenue, while at the same time minimizing the impact on its customers, employees and shareholder, as well as the economy of Québec.

With 1987 indicating a return to improved profitability, the transitional period is now drawing to a close.

2.1 *Review of the Recovery Strategy*

The major change of direction taken in the last few years was based on a **recovery strategy** defined in the *Hydro-Québec Development Plan 1983-1985 Horizon 1992*, and detailed in subsequent plans.

RECOVERY STRATEGY IMPLEMENTED OVER THE LAST FEW YEARS

Actions affecting financial commitments	Go ahead with the investment commitments for commissionings until 1985 and postpone construction of additional generating capacity.
Actions affecting revenue	Increase sales of electricity by a dynamic marketing effort on Québec and external markets.
Actions affecting expenditure	Cut operating expenditure.
Trade off to optimize the financial situation in the long term	Limit rate increases to encourage market penetration: • by accepting a short term reduction in net income • while assuring respect for essential financial criteria: - interest coverage of 1.00 - capitalization ratio of 25%.

2.1.1 *Actions Affecting Financial Commitments and Results*

At the end of 1981, 52% of the 10,283 megawatts from Phase I of the La Grande Complex at James Bay had been installed and 75% of the $13.7 billion required had already been invested. Despite the forecast surplus capacity, it proved profitable to complete construction and thus, five years later, increase Hydro-Québec's maximum available capacity to more than 28,000 megawatts and its property and plant in service to $28 billion.

All generating facilities to be commissioned after Phase I of the La Grande Complex were delayed, however. Thus, of the 26,000 megawatts that were to have been developed between 1985 and 1997, according to the construction program prepared at the end of 1980, only 6,500 or 25% is now being considered.

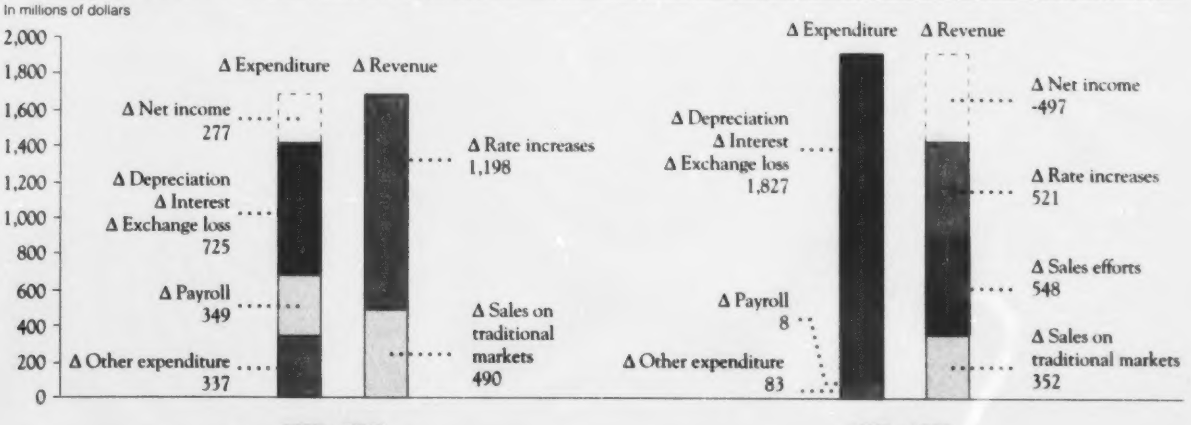
In spite of this reduction in financial commitments, the new installations meant substantial increases in expenditure. It is true that Phase I of the La Grande Complex was completed on time and within budget. However, the size of the commissionings, the write-off or transfer to operations of interest for preliminary studies of abandoned or suspended projects, the decline in the value of the Canadian dollar and the changes in accounting practices for exchange loss since 1984 meant substantially higher depreciation, interest expenditure and exchange loss.

The increase of $1,827 million in these items between 1982 and 1986 was two and one half times greater than that recorded between

1978 and 1982. Again, from 1982 to 1986, the low growth in Hydro-Québec revenue on its traditional Québec and external markets, amounting to $352 million, was offset by additional sales revenue of $548 million, resulting from the sales efforts described in the next section. In spite of a substantial slowdown in growth of the operations payroll and other expenditure, maintaining a balance between the growth of revenue and expenditure would have meant rate increases incompatible with the lower inflation and the prices of other forms of energy. This led Hydro-Québec to reduce its rate increases and allow its net income to fall.

FIGURE 1
IMPACT OF THE RECOVERY STRATEGY ON FINANCIAL RESULTS

Variation (Δ) in revenue and expenditure per four-year period*



*1986 breakdown revised.

2.1.2 *Actions Affecting Revenue*

The results obtained since 1982 show the extent to which sales efforts have been an essential component of Hydro-Québec's recovery strategy. On Québec markets, efforts took the form of industrial boiler, dual-energy heating and industrial rate discount programs. On export markets, attention was paid to increasing the capacity and the use of interconnections. These sales earned for Hydro-Québec additional revenue of $2,160 million between 1983 and 1987; they thus helped to substantially reduce spillage.

FIGURE 2
IMPACT OF SALES EFFORTS

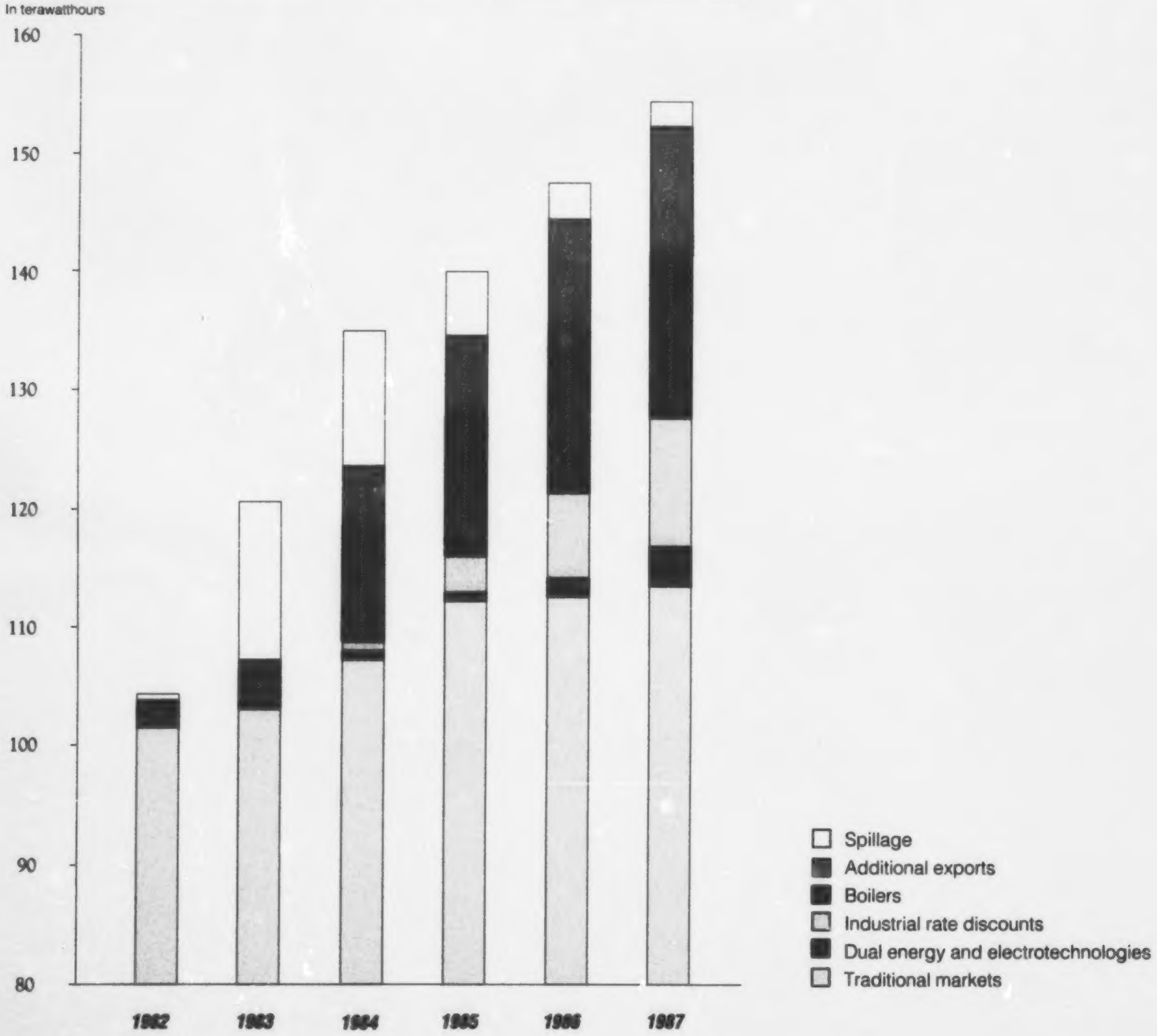


TABLE 1
SALES ASSOCIATED WITH MARKETING PROGRAMS AND ADDITIONAL EXPORTS

(in terawatthours)

	1983	1984	1985	1986	1987	Total 1983-1987
Marketing programs*						
Dual-energy heating						
• Single units	0.3	0.8	0.9	0.6	0.5	3.1
• Multiple dwellings	-	-	0.1	0.2	0.3	0.6
• General and industrial	-	-	0.1	1.0	1.7	2.8
Industrial rate discounts**	0.1	0.8	2.7	7.2	10.6	21.4
Boilers***	3.0	9.9	12.1	13.7	13.7	52.4
Electrotechnologies and other	-	-	0.1	0.3	0.8	1.2
Total	3.4	11.5	16.0	23.0	27.6	81.5
Additional exports	1.7	5.0	6.3	9.1	10.9	33.0
TOTAL	5.1	16.5	22.3	32.1	38.5	114.5

* Revised results.

** Includes sales to new aluminum smelters.

*** Corresponds to sales of surplus electricity in Québec.

TABLE 2
REVENUE FROM SALES EFFORTS

(in millions of dollars)

	1983	1984	1985	1986	1987	Total 1983-1987
Marketing programs*	56	204	290	331	392	1,273
Additional exports	60	139	169	217	302	887
TOTAL	116	343	459	548	694	2,160

* Revised results.

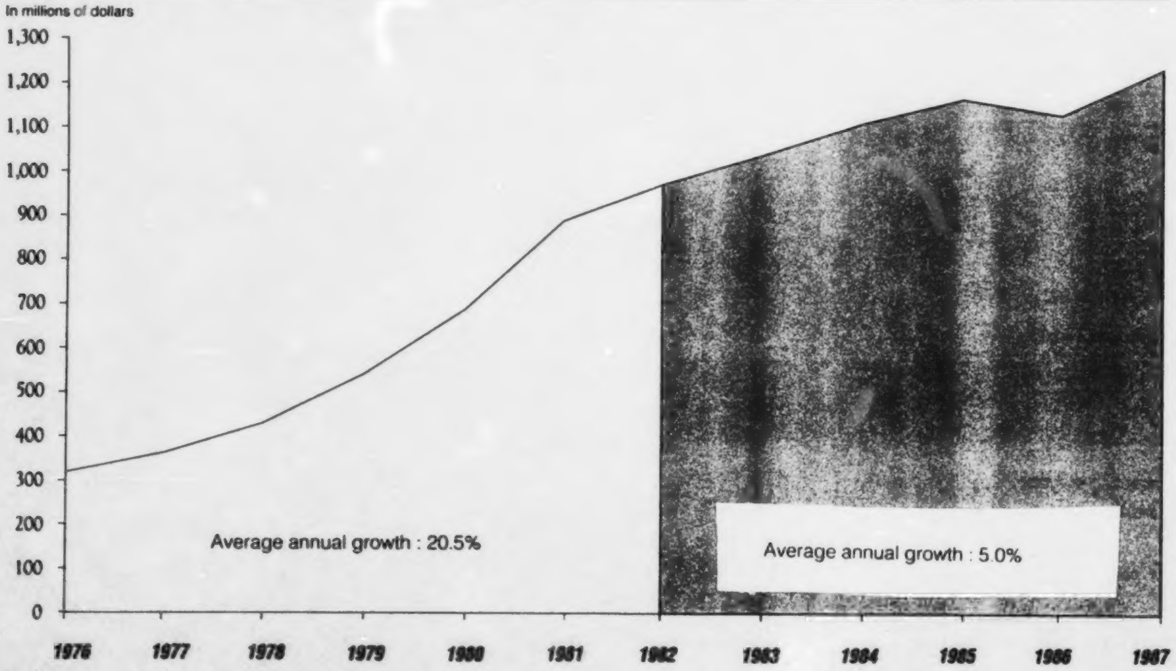
2.1.3 Actions Affecting Expenditure

Reducing and rationalizing operating expenditure, 60% of which is operations payroll, has been a high priority. The results in this area should be examined from several angles, not simply in terms of the major savings achieved in recent years. These results have now placed Hydro-Québec in a situation where, starting from a more acceptable level of expenditure, it can plan its budgets more in terms of the growth of its markets and activities, yet still pursue cost-cutting efforts. The 5.0% average annual growth in operating expenditure from 1982 to 1987, compared to the 20.5% recorded from 1976 to 1982, is a clear indication of the significance of this achievement.

Essentially, cost cutting resulted in a stabilization of the total payroll. The 16.5% annual growth in salaries and benefits from 1976 to 1982 was reduced to 1.3% from 1982 to 1987, as a result of a decrease in the number of employees, a reduction in the rate of growth of average remuneration and, to a lesser extent, a decline in retirement expenditure. Hydro-Québec reduced its lead in terms of the remuneration of its employees compared to that of employees in large companies operating in Québec as a result of collective agreements concluded in 1983 and 1986-87 with the various unions representing employees. The stabilization of the total payroll, which includes the manpower costs charged both to operations and to investment in fixed assets, not only helped to moderate the rate of growth of operating expenditure but also, to some extent, to reduce the costs of investment projects.

This rationalization of human resources, tied to the annual growth in deliveries of electricity from sales efforts, has had a favorable impact

FIGURE 3
CHANGES IN OPERATING EXPENDITURE*



* Expenditure, excluding purchases of electricity, depreciation of fixed assets and taxes.

on productivity. With fewer employees in 1987 than in 1982, Hydro-Québec has managed to increase its total sales by 8% per year. This has resulted in a reduction in the real unit cost of electricity. Thus, in constant 1987 dollars, the cost per megawatthour delivered dropped from nearly $40 in 1982 to $33 in 1987, regaining its 1978 level, before the imbalance between supply and demand for electricity had made itself felt.

2.1.4 *Limiting Rate Increases*

Between 1977 and 1982, rates in Québec, and the consumer price index in Montreal, grew by an average of 13.8% and 10% respectively, per year. From 1983 to 1987, Hydro-Québec limited its rate increases to an average of 4.6% per year, while inflation averaged 4.7%. This decision reflected the utility's desire to maintain its competitive position with respect to fuel oil and natural gas and to support its sales efforts to sell its surpluses.

The fall of the Canadian dollar and the price of oil resulted in a greater than anticipated drop in net income, which fell from an equilibrium level of $800 million in 1982 to $209 million in 1985. This dramatic drop in net income and, as a result, in the return on equity, caused the capitalization ratio to fall temporarily below the target of 25%.

2.1.5 *Management Consolidation*

With the positive performance by the Québec economy and the Canadian dollar, a recovery in the financial situation began to make itself felt in 1987 with net income of $508 million. Thus, the return on equity rose for the second consecutive year, after having dropped since 1982, when it was 15%. At 7% in 1987, it is coming closer to the cost of the debt, its minimum objective.

In order to consolidate this improvement in results and maintain its ability to compete, Hydro-Québec intends to pursue its efforts to increase productivity and reduce costs. The initiatives undertaken so far have promoted an increase in general productivity. Hydro-Québec is aware of the specific improvements that are still required, however.

The step-by-step rationalization process that is under way affects management and employees alike. Procedures will have to be modified accordingly and, in certain cases, work reorganized to achieve qualitative and quantitative improvements.

A progressive improvement in performance is still central to the priority management activities the utility intends to pursue, together with its partners.

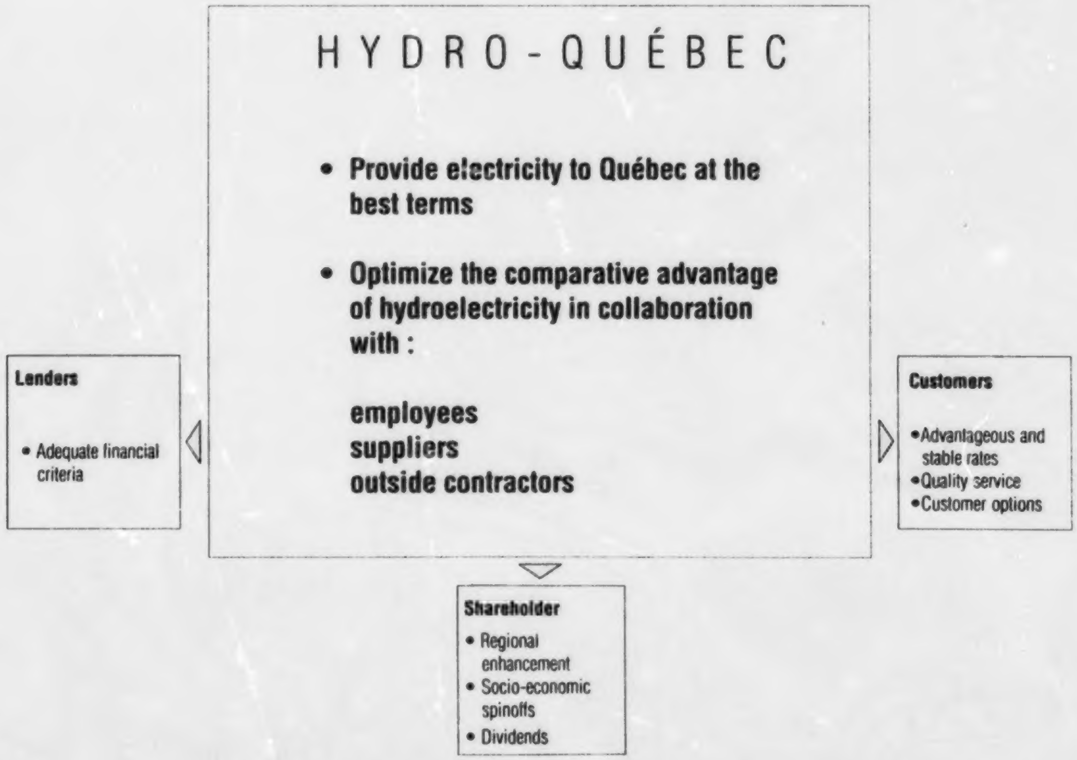
2.2 The Goals of Long Term Development

Parallel to the financial recovery strategy that has characterized Hydro-Québec's most recent development, the utility has begun to implement the **long term orientation** of the *Hydro-Québec Development Plan 1985-1987, Horizon 1994*. The corresponding strategies should allow an optimum response to the major orientations adopted for the development of the utility's main activities: expansion of the Québec and export markets to maximize the advantage of hydroelectricity, the progressive development of large projects and, ultimately, diversification.

LONG TERM ORIENTATION	
Fundamental Orientation	To provide electricity to Québec at the best conditions, optimize the comparative advantage that hydroelectricity constitutes for Québec and diversify into fields connected with or related to power and energy.
Development Orientations	• Domestic marketing that focuses on customer satisfaction, based on a pricing policy that maximizes the comparative advantage of hydroelectricity for Québec. • Marketing outside Québec to maximize profits from export sales as well as the other advantages offered by interconnections with neighboring systems. • More flexible development of the generating and transmission system to take into account all profitable markets. • Quality service that meets the expectations of all customer categories. • Technological development oriented toward the utility's short, medium and long term needs, associated with technological leadership that will contribute to a gradual diversification of activities.
Management Orientation	A flexible structure that allows decisions to be made close to where their results are felt and emphasizes strategic planning, supervision, coordination and control, accompanied by rigorous management practices stressing the measurement of results and the evaluation of performance. This structure also promotes development orientations, employee aspirations, an adequate return on equity and an overall improvement in the utility's financial situation.

This long term orientation should allow electricity to remain the major asset it has been for Québec since the turn of the century. With the collaboration of its employees, suppliers and outside contractors and in cooperation with the other land-use planners and developers, Hydro-Québec hopes to satisfy the expectations of its three main partners: its customers, the Government as shareholder and owner on behalf of all Québec, and the investors who lend the utility three-quarters of its capital requirement.

FIGURE 4
EXPECTATIONS OF HYDRO-QUÉBEC'S PRINCIPAL PARTNERS



HYDRO-QUÉBEC

- **Provide electricity to Québec at the best terms**
- **Optimize the comparative advantage of hydroelectricity in collaboration with :**

employees
suppliers
outside contractors

Lenders

- Adequate financial criteria

Customers

- Advantageous and stable rates
- Quality service
- Customer options

Shareholder

- Regional enhancement
- Socio-economic spinoffs
- Dividends

2.2.1 The Partners' Expectations

As a public utility, Hydro-Québec has an obligation to offer advantageous and stable rates and quality service. It must also diversify its products and services in order to provide **customers** with choices and opportunities to reduce their energy costs.

To the **Government**, its shareholder, which determines its mission, Hydro-Québec is accountable for its actions. It is the Government which must approve its rates policy, making sure that the supply of electricity meets criteria of sound financial management, especially with respect to the debt it guarantees. As a government, it must also oversee the availability and quality of the service to the public, regional enhancement, the rational use of environmental resources, and the important economic spinoffs of the utility's activities. These spinoffs are mainly the result of investment and operating expenditure linked upstream to the generation of electricity and downstream to the advantages users obtain from the marketing programs and advantageous rates. Hydro-Québec is also called upon to contribute to the economic well-being of society through dividends based on adequate financial criteria. By achieving these criteria, the utility is able to benefit from loans at advantageous rates from its **lenders**.

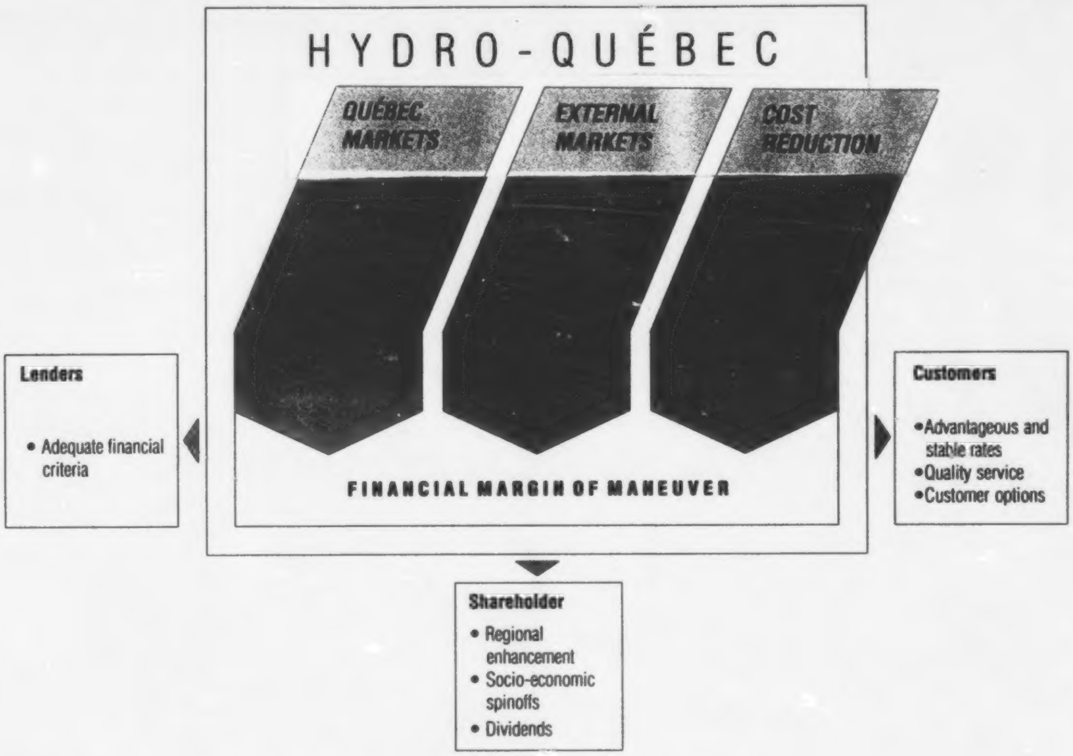
2.2.2 The Main Concerns: Development of Québec and External Markets and Cost Reduction

The expectations of all its partners underlie the utility's fundamental concerns in planning its long term development. The **development of Québec and external markets** are two main concerns. Since Québec has a substantial hydroelectric potential, for which Hydro-Québec serves in a sense as trustee, and since the development of these resources exerts a tremendous influence on the whole economy, it is in Québec's interest to adopt a multi-faceted development strategy for both domestic and export markets, in order to stimulate economic growth.

As a commercial undertaking, Hydro-Québec must be as efficient as possible and **cost reduction** is therefore a major concern. In the long term, various cost-cutting and productivity-enhancing strategies will make it possible to support market development by maintaining advantageous rates for Québec customers and competitive prices on the export markets.

Finally, a feature of the strategies recommended by Hydro-Québec in its development plan is that they are interrelated and that some respond to several major concerns at the same time. The rates policy is crucial in this respect. It is still central to Hydro-Québec's concerns because it can promote the efficient use of electricity in Québec, reduce costs and thereby improve the utility's ability to compete on external markets.

FIGURE 5
HYDRO-QUÉBEC'S PRIORITIES FOR MEETING THE EXPECTATIONS OF ITS PARTNERS


HYDRO-QUÉBEC
QUÉBEC MARKETS
EXTERNAL MARKETS
COST REDUCTION
FINANCIAL MARGIN OF MANEUVER
Lenders
• Adequate financial criteria
Customers
•Advantageous and stable rates
•Quality service
•Customer options
Shareholder
• Regional enhancement
• Socio-economic spinoffs
• Dividends

2.2.3 Risks and Financial Margin of Maneuver

In addition to the expectations of its principal partners and the major concerns of cost reduction and market expansion that result from them, an important aspect of Hydro-Québec's long term development is risk management. The imbalance into which the utility has been plunged in recent years and from which it is beginning to recover is a very good illustration of the risks to which it is increasingly subject. These risks are due to the physical environment and external context, and they include water conditions, exchange rates, economic activity, the demand for electricity and the price of fuels. They are the subject of strategies that seek to reduce, since they cannot eliminate, their impact on revenue and expenditure. But risks can also come from Hydro-Québec's own strategies, introduced to reduce its costs or increase its markets.

Generally, by the end of the century, Hydro-Québec expects to be in a situation in which the risks facing it are greater than in the past. It is therefore essential that the utility restore its financial margin of maneuver. This margin is necessary in order to avoid subjecting customers to the shocks felt by the utility through sharp rate increases.

To develop and use hydroelectric energy harmoniously with all partners, for the benefit of Québec society, and to be able to guard against the main risks are the goals Hydro-Québec has set for its long term development.

3. THE EXTERNAL CONTEXT

. . . .

Although Hydro-Québec does have some flexibility, it remains dependent on its environment because variations in a number of external variables directly affect its revenue and expenditure. Changes in the price of competing energies affect revenue from electricity sales for dual-energy systems and industrial boilers, as well as some export revenue. Such sales accounted for about 17% of total revenue in 1987. Furthermore, revenue generated by sales of firm electricity to the industrial sector are highly sensitive to variations in economic growth. These energy and economic variables have a short term impact on nearly 40% of revenue.

The expenditure most sensitive to the external environment is obviously interest and exchange loss on borrowings in foreign currencies. With nearly $1 billion of annual interest payments in US dollars and more than $200 million in other currencies, representing about 25% of total expenditure in 1987, the Canadian dollar exchange rate is a constant concern, particularly when repayments of principal in foreign currencies are added to interest payments. Exchange risk remains significant, although it is partially offset by US dollar revenue from exports of electricity to the United States. Moreover, interest rate movements directly affect interest payments for new borrowings and floating-rate debt.

Inflation in general affects much of Hydro-Québec's revenue and expenditure, especially the fixed interest rate costs associated with older debt. In periods of accelerating inflation, such fixed interest rate costs are less burdensome, but the opposite occurs in periods when inflation slows down.

Given this sensitivity to variations in the external context, its evolution must be anticipated as accurately as possible. Economic forecasts are used mainly to predict demand for electricity and define the financial framework. In the very short term, forecasts are situation-dependent, whereas in the long term, they tend to be structural, based on projections of underlying trends in systems. Since it is impossible to predict the timing and length of cyclical economic variations in the long term, long term economic growth is shown as an average rate of growth. Economic cycles are explicitly considered according to alternative scenarios, which incorporate specific recession and recovery hypotheses.

In addition to the economic and energy contexts, Hydro-Québec is subject to institutional changes. A number of major changes will probably affect the future of economic institutions in coming years and have an impact on Hydro-Québec activities. The most important for Hydro-Québec are international trade, tax reform and the deregulation of electricity exports.

Planning, construction and operation of Hydro-Québec facilities will be affected by local, national and international environmental attitudes. These are likely to show up in environmental laws and regulations.

Ultimately, analysis and forecasting of the external context seek to define the margin of maneuver available to Hydro-Québec in the short term for establishing and applying its management and development policies. They also seek to find the most effective objectives, strategies and programs to increase flexibility and reduce long term vulnerability.

3.1 The Economic Context

Since the early 1980s, economic systems have experienced major shocks. This has led to greater volatility in the external factors that affect Hydro-Québec. Worldwide structural modifications lie at the root of this: anti-inflationary monetary policies resulted in extremely steep rises in interest rates, which in turn caused the 1981-82 recession. Moreover, with monetary policies now focused on controlling money supply, interest rates generally have become very volatile. And the major variations in exchange rates and the virtually constant turmoil in energy markets for the last 15 years require continual adjustments by the marketplace. This instability appeared again in 1987 with the spectacular fluctuations in the financial markets.

3.1.1 North American Economy

The Short Term

In 1987, the North American economy experienced its fifth consecutive year of expansion, making this the longest such period since the end of World War II. Economic growth, especially in Canada, was surprisingly strong. This growth, combined with accelerating inflation, was reflected in major increases in commodity prices and the firming of oil prices, resulting in rising interest rates during most of 1987. However, the October 19 stock market crash intervened to change prospects of economic growth and inflation, causing interest rates to fall sharply and intensifying the continued devaluation of the US dollar compared to European currencies and the Japanese yen. However, the Canadian dollar was less severely affected in 1987, strengthening against its US counterpart. It benefited from solid economic performance, rising resource prices, the flight of capital from the United States and the prospect of a free trade agreement between the two countries.

In view of the current vigor of the North American economy, a recession in the short term seems quite unlikely, in spite of the stock market collapse. Exports and investments should stimulate industrial production enough to sustain the economy in both the United States and Canada for most of 1988. However, there are many problems that could persist or intensify and lead to a severe slowdown in the North American economy: continued deterioration of consumer finances, increasingly heavy indebtedness of various economic agents, enormous trade imbalances, large budget deficits, and excessively restrictive policies in foreign economies. Nevertheless, there is nothing to suggest that such a slowdown would be long-lasting.

Continued expansion, devaluation of North American currencies against foreign currencies, and strong resource prices will hold the rate of inflation steady in 1988 and may limit any possibility of a more expansionary monetary policy, especially since budget deficits will remain very high in coming years. The subsequent economic slowdown should result in some softening of prices and allow a more flexible monetary policy.

The Canadian dollar will benefit from the free trade agreement and rising prices for raw material but could come under pressure from a weakening of the Canadian economy, only to strengthen in the subsequent recovery.

The Long Term

In the longer term, the North American economy should maintain moderate growth. Industrial restructuring and more conservative monetary policy have put the economy on a better footing for growth than at the end of the 1970s. However, two constraints will continue to impede economic activity. The tax burden will probably continue to grow, as part of government deficit-control measures. And real interest rates will remain above historical levels because of the inadequate level of savings in the United States and the higher risk premiums demanded by investors as protection against the vagaries of monetary and fiscal policies and the potential rekindling of inflation.

In the long term, the Canadian dollar should stabilize against the US dollar. The recovery of prices for raw materials and the free trade agreement will work in its favor, while the problems experienced by the Canadian government in controlling the deficit and slightly higher inflation in Canada than in the United States will work against it. But like its US counterpart, the Canadian dollar will continue to lose value against European currencies and the Japanese yen.

TABLE 3
MAIN ECONOMIC PARAMETERS

(in %)

	1986	*1987**	*1988*	*1989*	*1990*
Québec real gross domestic product	3.3	5.0	2.8	1.5	2.5
Canadian consumer price index	4.1	4.4	4.6	5.0	4.5
Interest rates on long-term bonds (10 years and more)					
• Canadian Government	9.3	9.7	10.5	9.9	9.7
• US Government	7.8	8.5	9.4	8.5	8.7
• Hydro-Québec in Canada	9.9	10.4	11.4	10.7	10.5
• Hydro-Québec in US	9.1	9.6	10.5	9.6	9.9
Canadian dollar exchange rate at year-end					
• US dollar	0.724	0.769	0.758	0.75	0.75
• Deutsche Mark	1.394	1.208	1.175	1.133	1.110
• Yen	114.5	93.1	91.3	87.8	85.1
Average Canadian dollar exchange rate for the year					
• US dollar	0.719	0.754	0.763	0.75	0.75
• Deutsche Mark	1.563	1.354	1.211	1.133	1.110
• Yen	121.2	108.8	94.4	87.8	85.1

* Estimate.

3.1.2 *The Québec Economy*

In its fifth consecutive year of expansion, Québec experienced growth estimated at 5% of its real GDP. Housing starts continued, thereby boosting growth by a host of related sectors. Reflecting the solid performance by the Québec economy, non-residential investment also posted rises in 1987, as seen in the construction of numerous commercial buildings, especially in Montreal. In all likelihood, the economic situation will remain favorable for most of 1988. The completion of housing units begun in 1987 will support personal consumption and some major investment projects will continue. However, a slowdown may occur by 1989.

Québec sources of growth are likely to dry up somewhat, as consumer spending runs its course and residential and non-residential construction shrinks. Moreover, it is unlikely that exports will increase substantially, given the projected situation of trading partners. On average, Québec should experience growth of 2.3% of its real GDP between 1987 and 1990.

TABLE 4
COMPARISON OF ECONOMIC FORECASTS FOR 1988

	Average	***Forecast range*** Upper Quartile	Lower Quartile	***Hydro-Québec forecasts***
Québec real gross domestic product	2.7	3.0	2.2	2.8
Canadian consumer price index	4.4	4.9	3.8	4.6
Interest rate on long-term bonds (10 years or more)				
• Canadian Government	9.8	10.5	9.2	10.5
• US Government	8.9	10.0	7.8	9.4
Canadian dollar exchange rate at year end				
• US dollar	0.765	0.753	0.768	0.758
• Deutsche Mark	1.221	-	-	1.152
• Yen	96.2	-	-	89.4
Average Canadian dollar exchange rate for the year				
• US dollar	0.758	0.751	0.765	0.763
• Deutsche Mark	1.240	-	-	1.211
• Yen	98.5	-	-	94.3

The Long Term

After 1990, the potential growth of the Québec economy is estimated at 2.5% per year until 2006. This scenario is based on a number of assumptions, the most important of which can be summarized thus. The population of 15 year olds and over will increase by 0.5% per year between 1990 and 2006, which is less than half the growth experienced since 1971. This slowdown will be especially marked after 2001. Québec's sustained increase in productivity will sharpen its competitive edge. Export markets, in the United States and elsewhere, will be maintained. However, uncertainties about future developments in these areas, as well as the international situation, suggest a plausible range for long term growth by the Québec economy between 1.7% and 3.0%.

Although population growth will be slow, changes in the age pyramid will support the formation of new households. About 750,000 new households will be created in Québec by 2006, an increase of 1.4% per year. This increase is half that recorded between 1971 and 1986. For this reason, economic development will be based mainly on sectors that look outward. Moreover, growth in demand for electricity will be increasingly dependent on a few industries. This is due to the gradual saturation of the residential market and, to a lesser extent, the tertiary sector.

It is therefore worth taking a closer look at the projected growth of the most important industries.

Pulp and paper mills are Hydro-Québec's largest industrial customers overall. They accounted for more than 30% of sales of firm electricity to industry in 1986. Sales of electricity to this industry will depend on the growth of production but also on the penetration of new electricity-intensive technologies.

In the long term, unit output of Québec's pulp and paper mills should grow by 1.3% per year, as in last year's forecast. These forecasts assume that the present competitive position on the North American market is maintained but there is a relative decline on other markets. Despite the spread of processes which are sparing in their use of wood but intensive in their use of electricity (thermomechanical or chemi-thermomechanical pulp), whose share in overall pulp production should rise from 20% in 1986 to about 65% in 2006, conservation of forest resources under the new Québec forest management system, will significantly limit paper production for the next 20 years.

However, the uncertain future of various decisive factors for Québec's pulp and paper industry offers scenarios in which long term growth in output could be between 0.8 and 1.9% per year.

The metals smelting and refining industry accounted for more than 23% of Hydro-Québec's firm electricity sales to industry in 1987. This sector consists of a number of different metals, but aluminum and magnesium offer special interest because of their high consumption of electricity.

Very fierce competition from other metals and plastics suggest growth in world consumption of primary aluminum of about 1% per year until the end of the century, a rate well below the performance of this sector in recent years. However, because of this competition and the upward trend in electricity prices, especially in Europe, most inefficient smelters should be closed by the middle of the next decade, and operations relocated where the price and availability of energy are more advantageous.

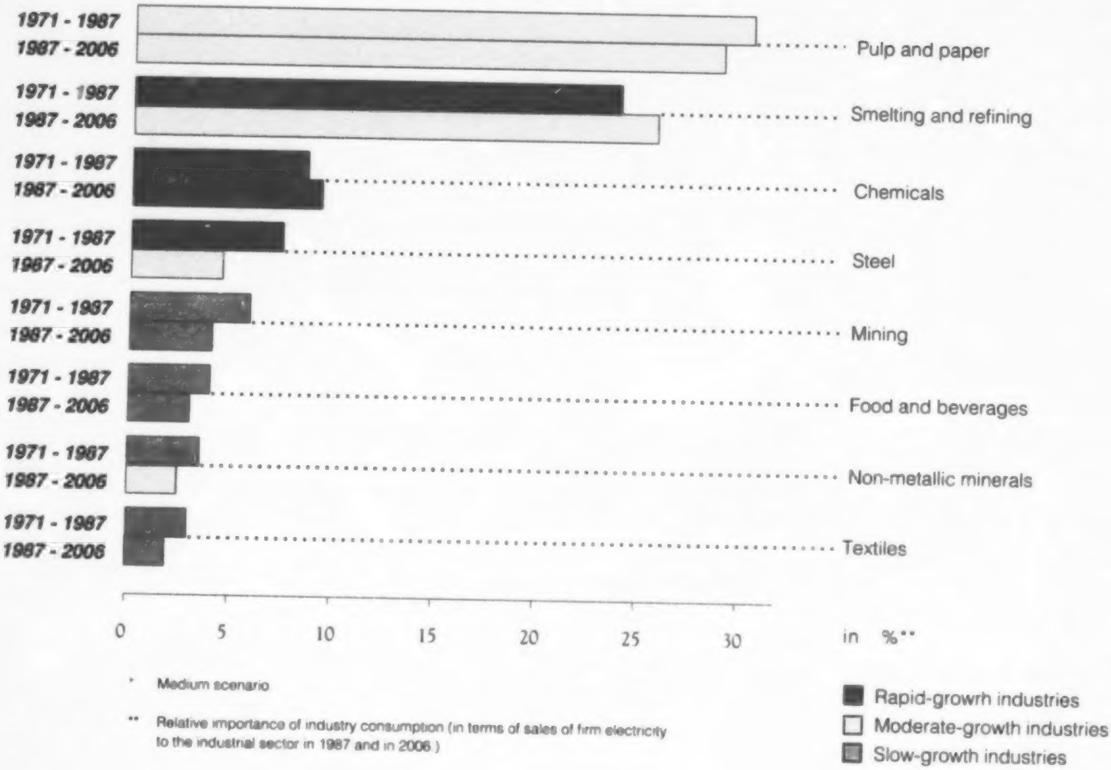
Québec could benefit from this worldwide reorganization and new needs for capacity and could attract the equivalent of two aluminum smelters, or 460,000 metric tons as forecasted last year. If so, Québec would supply over 11% of world primary aluminum needs within the forecast horizon.

Uncertainty about future developments in aluminum consumption and plant relocation suggest a possible range of capacity for new aluminum smelters in Québec of from 230,000 to 775,000 metric tons by 2006.

Furthermore, the 60,000 metric ton Norsk Hydro magnesium plant, for which an electricity contract was signed in 1987, should be commissioned starting in 1989 and be operating at full capacity in 1993. Magnesium is one of the metals requiring the greatest amount of electricity in its production. Indeed, its unit consumption is greater than that of aluminum. Québec is thus particularly well situated to play a decisive role in world magnesium production.

FIGURE 6
LARGE - AND MEDIUM - POWER INDUSTRIES

Distribution by sales of electricity and rate of economic growth



* Medium scenario

** Relative importance of industry consumption (in terms of sales of firm electricity to the industrial sector in 1987 and in 2006.)

3.2 The Energy Context

The collapse of fuel prices in 1986 brought about substantial changes in the behavior of buyers and producers in these markets. The volume of surpluses had created a buyer's market and intensified competition among suppliers. Fundamental to the issue was the share that OPEC wanted of world production. The high prices for crude oil between 1980 and 1985 had created expectations of continuous price rises. A downward correction in demand resulted, and OPEC's share in world production fell from 56% in 1980 to less than 40%. The expectation was that some equilibrium would be restored between the two price extremes recorded in 1983 and 1986. In fact, 1987 did witness some recovery for crude oil and its by-products and natural gas and coal, its principal competitors. Over these years of instability, Hydro-Québec went after markets traditionally held by heavy fuel oil (industrial boilers) and light fuel oil (home heating). The market conditions of these products have changed, and it is appropriate to determine their impact on Hydro-Québec activities.

3.2.1 Crude Oil and Petroleum Products

At the end of 1986 and during 1987, Saudi Arabia reasserted its leadership of OPEC. The evident resistance of non-OPEC producers had been a great shock and caused the country first to reduce its own production and then to force its fellow cartel members to reduce theirs. Thus, a production agreement, viewed skeptically by western countries, allowed the target price of US$18 per barrel to be not only reached but even exceeded in 1987. The price of crude reached a peak of US$22.43 in July 1987, because of the Iran-Iraq war. The fighting caused a panic due to the potential of a breakdown in supply from the Persian Gulf. From a strictly economic point of view, the oil market is glutted, and at year end, the effect has been to depress prices, in spite of the weakness of the US dollar on European and Asian exchanges.

These short term events have resurrected expectations of price rises. However, even though a number of analysts in both the public and private sector have sharply raised their long term forecasts, these adjustments alone appear insufficient to substantially modify the medium and long term view. This position is extremely cautious, and raising our long term forecast solely on the basis of data from 1987 would be premature.

Fundamentally, the oil market will be characterized by excess supply. Demand will increase, probably at a rate of 0.5 to 1.0% per year, while energy conservation measures and the replacement of oil by other energy sources in western nations and Japan will continue, but at a slower rate than that observed in the past. Consequently, the price of oil should remain around US$20 (in 1986 dollars) until the end of the century.

The main fuels derived from oil (heavy fuel oil, light fuel oil and gasoline) will follow the general trend for crude. However, conditions of supply and demand specific to each of these products may modify the relationships historically observed among them.

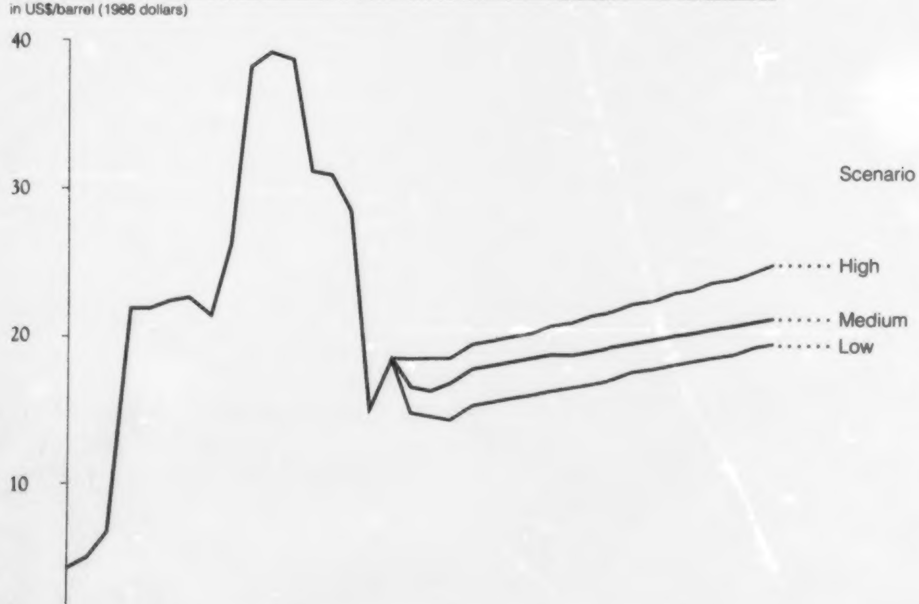
For example, light fuel oil has lost more than half the heating market in Québec over the last 10 years; its price is now quite low compared to the price of crude and should remain so for several more years.

As in the medium scenario, the high and low scenarios reflect structural changes in the economy and therefore represent long term trends. Variations in the economic context could intervene and over periods of less than five years, the price of crude could vary sharply from the medium hypothesis, even exceeding the high and low value range.

FIGURE 7
LIGHT CRUDE OIL (WTI)*

Price scenarios

in US$/barrel (1986 dollars)



* West Texas Intermediate.

TABLE 5
CRUDE OIL PRICE PROJECTIONS FOR 2000*

(US$ 1986)

	Low	Base	High
Hydro-Québec	18	20	24
Consulting firms			
Stanford Research Institute (SRI)	9	27	40
Data Resources Inc. (DRI)	-	35	-
Petroleum Economics Ltd.	25	35	45
Hycarb Engineering Ltd.	-	28	-
Shearson Lehman Brothers	-	25	-
Arlon Tussing	10	-	20
Oil companies			
Shell Oil Co.	18	-	25
Conoco Inc.	-	29	-
Ashland	26	29	30
National Petroleum Council	21	-	36
Public agencies			
National Energy Board Canada	18	-	27
Énergie et Ressources - Québec	25	-	33
Energy, Mines and Resources Canada	23	-	30
Department of Energy - US	27	33	42
Agence Internationale de l'Énergie - France	-	30	-
Institute of Energy - Japan	-	30	-
World Bank	-	22	-

SOURCE : Energy, Mines and Resources Canada.
* West Texas Intermediate.

3.2.2 *Competition from Natural Gas*

The November 1986 deregulation has not yet been completely absorbed by the market. Discounts have multiplied and are aimed at an ever larger market, including industrial and commercial sectors as well as the residential sector, through the grouping of purchases. Demands for permits from regulatory agencies are also multiplying; most involve agreements between consumers and producers, with consumers paying only transportation costs. However, this situation is even more true in Ontario, which is Canada's main natural gas market, than in Québec. Ontario consumers realize that the quantities currently being shipped are well below the capacities of the Canadian pipeline system. Thus, strong competition firstly among gas producers and secondly with other sources of energy is depressing gas prices. In Québec, on the other hand, distributors have not passed all these decreases on to consumers. They have increased the percentage of distribution costs in their rate, and the Régie de l'électricité et du gaz approved a 4.6% increase for the residential sector in October 1987. So gas is more expensive than electricity in that sector but the industrial sector continues to enjoy rebates based on volume and point of delivery.

The US market is another crucial component of the Canadian price of natural gas. Canadian producers believe that the US market will show a demand surplus in the mid-1990s and they face the challenge of staying in business in the short term, at the risk of substantial losses. Meanwhile, as long as that condition does not materialize, in the short and medium term, the price of natural gas will remain below the price of heavy oil, and discounts will be granted according to volumes purchased and regions served. In the longer term, US gas surpluses will be absorbed so that the US market remains attractive for Canadian natural gas. As a result, the price of Canadian natural gas should be equivalent to that of heavy oil on the Canadian market, to retain parity with this product thereafter.

3.2.3 *Competition from Coal*

Coal is the oil-replacement fuel of choice in the United States, because of its abundance, proximity and the self-sufficiency it offers. But its price, compared to heavy fuel oil, plus environmental impact and high handling and storage costs, have always impeded its penetration of the electricity generation market, where it currently accounts for about 55% of energy needs.

The coal market consists of two kinds of products: metallurgical coal and thermal coal. They come essentially from the same regions and same producers. US metallurgical coal producers have lost a very large part of the Japanese market to Australia. To offset these losses, they have had to settle for low prices in order to increase their share of the thermal coal market. Here, however, they come up against environmental concerns and the higher costs of supply to their primary customers, the US electric utilities, who account for 85% of thermal coal deliveries. The price of coal into the generation station must be low enough to offset the high investment costs. Before the first oil shock of 1973, the unit price (per BTU) of coal delivered to the generating station was more than 65% of the price of heavy fuel oil and 130% of the price of natural gas. Yet even in these conditions, coal was not in high demand.

The two oil shocks reduced coal to 30% of the price of heavy fuel oil per BTU in 1981 (55% of the price of natural gas), and coal deliveries, between 1975 and 1981, grew by 6.6% per year. However, the 1986 collapse of oil prices raised coal to 60% of the price of heavy fuel oil, and coal deliveries fell off by 1.1% that year.

The price relationship between the two products seems to be direct. If coal producers want to retain their market share, the unit price of coal at the generating station door must remain about 50% of the price of heavy fuel oil, its major competitor. This assumption underlies the forecast of the price of US coal.

3.2.4 *Electricity and Competing Fuels in Québec*

The light fuel oil market has excess supply and its price on the home heating market has remained relatively low, although higher in 1987 than in 1986. The competitive position of electricity with respect to fuel oil improved in 1987. For a typical home using 14,000 kilowatthours per year, electric heating costs 21% less than using fuel oil in older systems.

As for natural gas, deregulation has left a depressed market and the border price has dropped substantially. Nevertheless, the residential sector is not benefiting completely from the price war among producers. Price increases were granted by the Régie de l'électricité et du gaz in October 1987. All operating costs included, for the typical consumption of 14,000 kilowatt-hours per year, natural gas heating is 21% more expensive than electricity in older systems.

For medium and large consumers in the commercial and institutional sectors, natural gas and fuel oil are about 25 to 50% cheaper than firm electricity. On the other hand, dual-energy and heat-pump rates allow electricity to be competitive and to remain more attractive than other forms of energy. Furthermore, all-electric systems have remained popular in this sector because they allow construction cost savings.

Comparisons in the industrial sector are somewhat more difficult because a range of elements other than price influences energy choices. For example, firm electricity is in heavy demand as a result of greater modernization by Québec industry, even though according to energy bills it is more expensive than natural gas and fuel oil. The main reasons for this phenomenon are the space savings and productivity gains associated with electricity.

In 1985, Hydro-Québec created its Electrotechnology Implementation Assistance Program for promoting and developing electrotechnologies in industry. Because of the gains in efficiency and productivity from using high-performance electrotechnologies, firm electricity has become competitive with fuels. This program will allow a transition from a period of surpluses sold at extremely low prices through marketing programs, to a period of customer loyalty for firm electricity because of its general advantages.

TABLE 6
ELECTRICITY'S COMPETITORS IN THE HOME-HEATING SECTOR

(4th quarter of 1987)*

	Electricity = 100**			
Heating System	***Fuel Oil******	***Natural Gas******	***Typical Case*******	
			Fuel Oil	***Natural Gas***
Old	108 à 131	103 à 136	121	121
New	95 à 118	98 à 131	107	116
High efficiency	89 à 112	83 à 115	102	101

* Price of fuel oil : $0.25 per litre. The price of natural gas includes the 4.6% increase in the residential sector in effect since October 1, 1987.

** The all-electric heating system is used as a reference : it has been given an index value of 100.

*** Consumption equivalent to 26,000 kWh and 10,000 kWh for the upper and lower limits, respectively. Reference efficiency varies according to the type of system from 60 to 75% for fuel oil and 67.5 to 90% for natural gas ; electricity is 100%. Includes maintenance costs, insurance, and sales tax ; does not reflect annual costs associated with purchase and installation.

**** Average consumption to heat a single-family dwelling in Québec : 14,000 kWh per year or the energy equivalent.

3.3 The Institutional Context

The future of Hydro-Québec is largely affected by the reforms of the institutional structures that govern economic activity. In coming years, expected changes in Canada's trade environment, the role of the National Energy Board, the tax system and the legal system will have major impacts on Hydro-Québec's activities.

3.3.1 The Free Trade Agreement

The free trade agreement between Canada and the United States does not fundamentally modify the trade context in which Hydro-Québec operates because there are no tariff barriers to electricity.

However, the agreement proposes more open access to markets, especially for energy, and a binational panel to review the applicability of US and Canadian trade laws. These changes will help reduce the uncertainties with respect to protectionist measures that had threatened Hydro-Québec exports. The impact will also be favorable for customers who are large consumers of electricity and export to the United States. Hydro-Québec's marketing policies generally comply with the criteria applied in the United States, and this agreement is consistent with its development orientations.

3.3.2 The Role of the National Energy Board

In June 1987, the National Energy Board (NEB), the agency responsible for issuing the licenses and certificates authorizing Hydro-Québec to export electricity to the United States, submitted various options to the federal government on the existing regulations governing electricity exports. This report was a follow-up to the NEB's 1986 survey of the interested parties. Hydro-Québec had then submitted a brief recommending greater liberalization in the regulation of electricity exports. The Minister of Energy, Mines and Resources is preparing to make recommendations to the Government on proposed changes in these regulations.

Furthermore, the free trade agreement introduces elements that imply some relaxation in NEB regulatory control. Thus, Canada has undertaken to eliminate the third NEB price test, which determines whether the export price was substantially less than the least costly alternative for the US buyer. Apart from this undertaking, the agreement does not impose any major amendments to existing NEB regulations.

3.3.3 *Reform of Indirect Taxation*

In 1987, the Government of Canada began an important tax reform, proposing in the first stage, to take effect in 1988, a reduction in personal and corporate tax exemptions and a lowering of tax rates. The federal government also intends to make major changes in the sales tax in coming years. The reform proposes to introduce a sales tax that would be collected at every step in the production and marketing of goods or services. This multi-stage sales tax would also apply to various sources of energy not currently subject to federal sales tax. This expansion of the tax base would be combined with a reduction in tax rates. The Government of Québec is examining the possibility and desirability of bringing its tax system in line with that of the federal government.

These changes could have a substantial impact on Hydro-Québec's activities. The imposition of a new sales tax on electricity sold in Québec and Canada could mean additional expenditure of hundreds of millions of dollars. The competitive position of electricity on Canadian markets could also be affected, depending on the reform's impact on the price of natural gas and fuel oil. There should be no impact on the penetration of electricity on US markets because exports of electricity outside Canada would not be taxed. Moreover, the impact of the tax reform on Hydro-Québec's commercial and industrial customers will be lessened by the fact that they can deduct the tax paid on their purchases of electricity as a tax credit on inputs.

3.3.4 *The Legal Context*

With respect to the suit involving the Churchill Falls energy contract involving Newfoundland's right to recall 800 megawatts of power, in May 1986, the Supreme Court of Canada granted the Newfoundland Solicitor General leave to appeal the decision rendered by the Newfoundland Court of Appeal and granted leave to CFLCo to appeal the decision of the Québec Court of Appeal. These two appeals are now in preparation.

3.4 *The Natural and Human Environment*

For a number of years, environmental questions have raised a series of increasingly strategic concerns about the utility's activities. These concerns are shared by all levels of government in Canada and are of international interest as well. Thus the United Nations founded the World Commission on the Environment and Development, whose report was made public in 1987. Federal and provincial authorities have subscribed to this effort by creating a national task force on the environment and the economy, consisting of government representatives, industrial leaders and environmentalists. The recommendations of the task force are intended to establish a comprehensive environmental strategy directly related to economic development objectives.

Changes in the environmental laws and regulations are likely to modify certain planning, construction and operations practices used for Hydro-Québec installations. For example, 1986 saw the introduction of a federal environment bill on preventing pollution from contaminants. The bill is intended mainly to ensure control over potentially dangerous products at various stages in their life cycle. In Québec, the Forests Act governing public and private forests was adopted. Under this Act, forests in the public domain are subject to standards that vary according to the territorial units involved. Moreover, the Pesticide Act, the draft bill on endangered species and the forthcoming revision of the Regulation respecting hazardous wastes represent other amendments of environmental laws and regulations. Of regional interest is the coming into force of the land-use plans of regional-county municipalities whose goals are binding on Hydro-Québec.

The importance the public ascribes to environmental concerns is confirmed by all surveys. The creation of the Fondation québécoise en environnement, to support the efforts of more than 800 groups and agencies in Québec, testifies to the significant increase in public concern. The execution of projects in recent years has revealed the growing value placed by the public on certain components of the environment and the emergence of concerns that are not governed by laws or regulations. Protection of the integrity of landscapes and heritage buildings, as well as fears related to environmental hazards such as mercury, herbicides and the effects of electrical and magnetic fields are areas where Hydro-Québec must continue its research and provide appropriate mitigative measures where required.

Hydro-Québec has substantial experience in environmental matters. A separate publication traces Hydro-Québec's involvement in Québec's environmental concerns, and its major future orientations in this field.

4. THE QUÉBEC MARKETS

A two-fold approach is used to study the Québec markets. First, Hydro-Québec sales of firm and surplus electricity are examined sector by sector: residential and farm, general (which includes businesses and institutions) and industrial. Second, Québec's total electricity consumption is compared with Québec consumption of oil and natural gas[1].

This allows a clearer understanding of the factors that determined growth in sales of electricity in the past and will affect them in the 2001 horizon. From 1971 to 1986, Québec's general energy requirements increased only slightly. During this period, electricity replaced a major portion of the oil used in heating applications, which helped increase electricity's share of the Québec energy market. However, from 1986 to 2001, oil replacement will occur less readily, and Hydro-Québec's marketing approach, sales programs and rates policies must take this into account. The general availability and low cost of electricity, combined with economic and demographic growth, affect electricity demand in Québec. Still, the utility's marketing activities remain a driving force in the growth in demand for firm electricity in Québec.

Further in Chapter 4, the discussion turns to the orientations of Hydro-Québec's marketing plan and concludes with an examination of the target scenario of Québec electricity demand.

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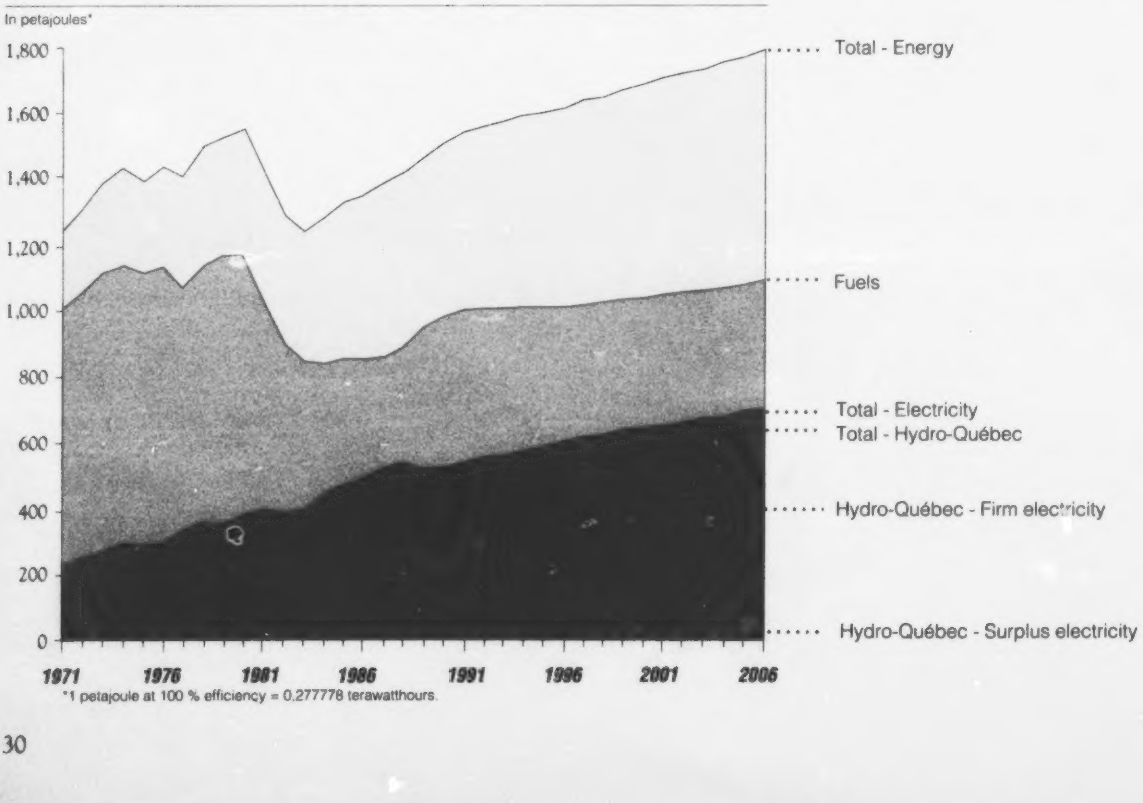
[1] To include the Hydro-Québec consumption sectors in Québec's energy mix, certain adjustments must be made. These mainly involve adding consumption by municipal distribution systems and neighboring power systems such as Alcan's.

4.1 Hydro-Québec Sales of Electricity as Part of the Québec Energy Mix

Increases in electricity sales from 1971 to 1986 were largely supported by rising oil prices which promoted oil replacement on a number of markets. Growth from 1986 to 2001 will be based more on modernization in the industrial sector and the arrival of new large-power customers, attracted by the relatively low price of electricity in Québec. During this period, sales to the industrial sector will account for 56.5% of the total increase of 59.1 terawatthours in sales of firm electricity. The remainder of the increase (43.5%) will depend essentially on demographic and economic changes in the residential and farm sector and the general sector.

Overall energy consumption by the residential, commercial and industrial sectors grew by only 0.4% per year from 1971 to 1986, when it reached 988 petajoules. In addition to the energy savings resulting from more efficient consumption, insulation, heating systems and processes, the replacement of oil by electricity and to a lesser extent by natural gas accounted for the small rise in energy consumption in Québec. Gains from conservation or replacement will be more difficult to achieve in the future, and assuming growth of 2.1% per year, overall energy consumption could reach 1,177 petajoules in 2001.

FIGURE 8
ENERGY CONSUMPTION IN QUÉBEC



*1 petajoule at 100 % efficiency = 0,277778 terawatthours.

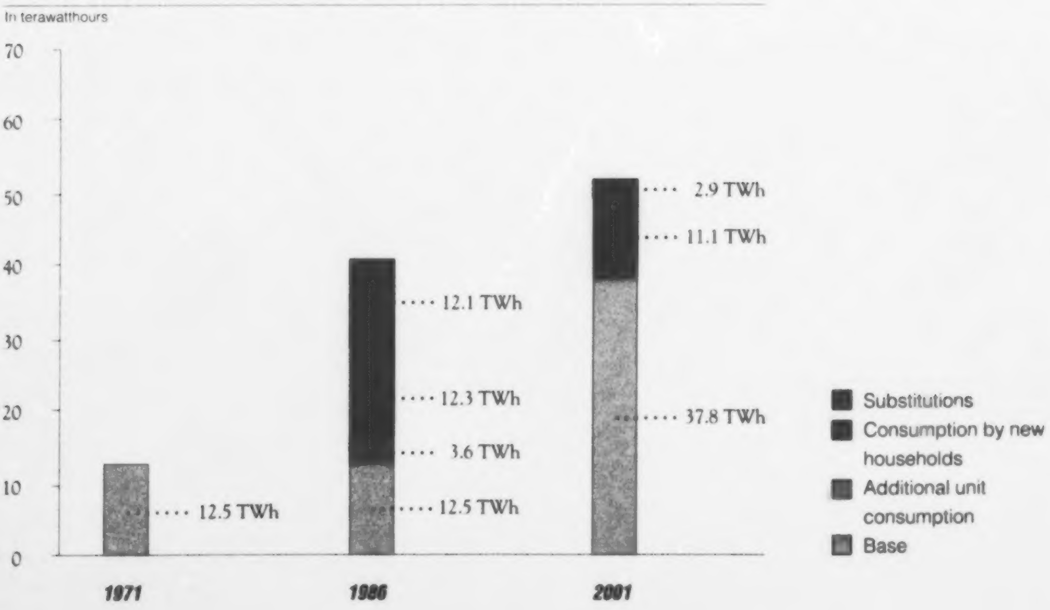
This analysis holds, even with the inclusion of the transportation sector, where energy conservation reduced consumption during the first analysis period. Still, inclusion of this sector brings total Québec energy consumption from 1,260 petajoules in 1971 to 1,353 in 1986 and to 1,705 petajoules in 2001. This corresponds to annual growth rates of 0.5% for the first period and 1.6% for the second.

Residential and Farm Sector

Between 1971 and 1986, residential and farm consumption of electricity more than tripled. The 28-terawatthour increase recorded during this period was shared almost equally between oil replacement and demographic growth, while the effect of more widespread use of electrical appliances was almost entirely offset by energy conservation.

From 1986 to 2001, only 11.2 terawatthours will be added to demand, of which 8.3 terawatthours will come from an increase in the number of households. After 1986, electricity conservation measures will reduce consumption for housing already built at that date. This accounts for the decrease in base consumption between 1986 and 2001.

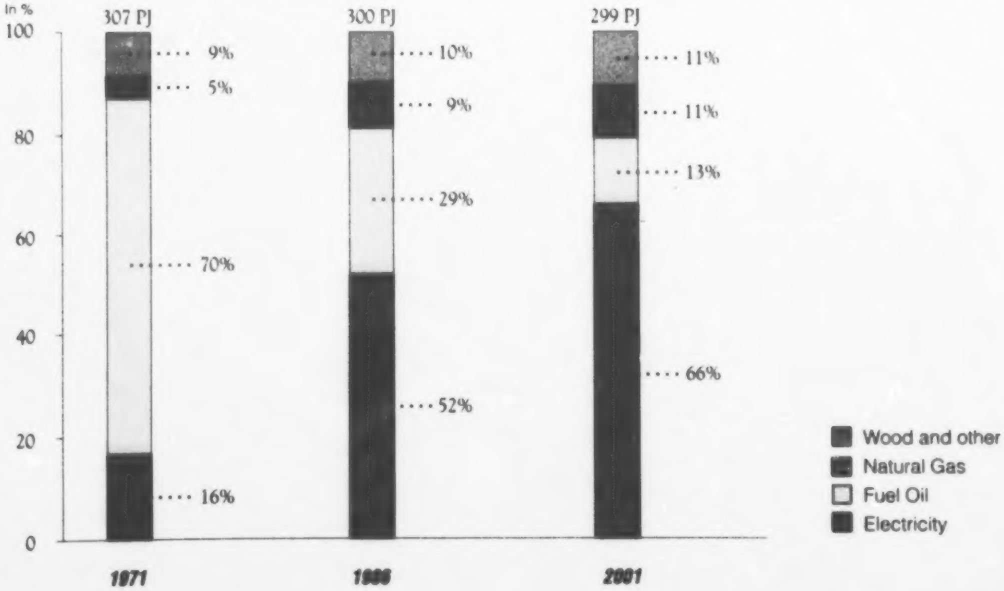
FIGURE 9
HYDRO-QUÉBEC SALES TO THE RESIDENTIAL AND FARM SECTOR



In the 1986 energy mix, electricity accounted for 52% of the residential market, oil 29%, natural gas 9% and other forms of energy 10%. That same year, electricity heated 66% of dwellings and oil 20%. By 2001, 260,000 dwellings heated with oil will convert to electricity, adding 2.9 terawatthours to Hydro-Québec's electricity sales, and raising to 79% electricity's share of the home heating market.

The replacement of oil heating systems with electricity has meant substantial energy savings. Because electric heating systems are more efficient, total energy consumption in the residential sector dropped 0.2% per year from 1971 to 1986, to 300 petajoules. From 1986 to 2001, energy consumption will stagnate because the energy saved, as oil is replaced by electricity, will be equivalent to the additional energy needs.

FIGURE 10
ENERGY MIX IN QUÉBEC'S RESIDENTIAL SECTOR

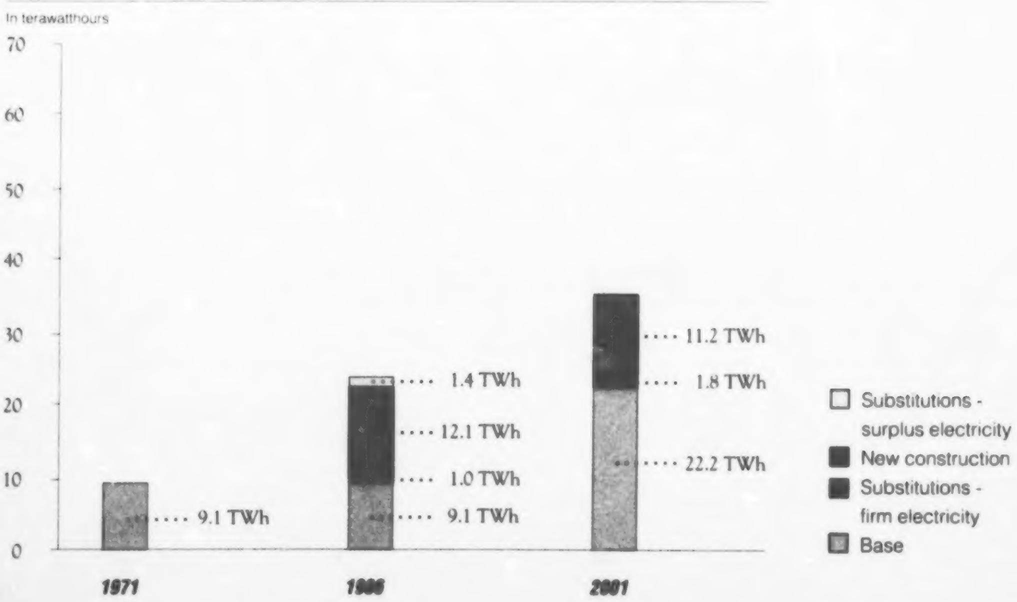


General Sector

From 1971 to 1986, construction of commercial buildings represented more than 12 terawatthours of the 14.5-terawatthour increase in sales to the general sector. Another 1.4 terawatthours came from electrification of oil-fired boilers.

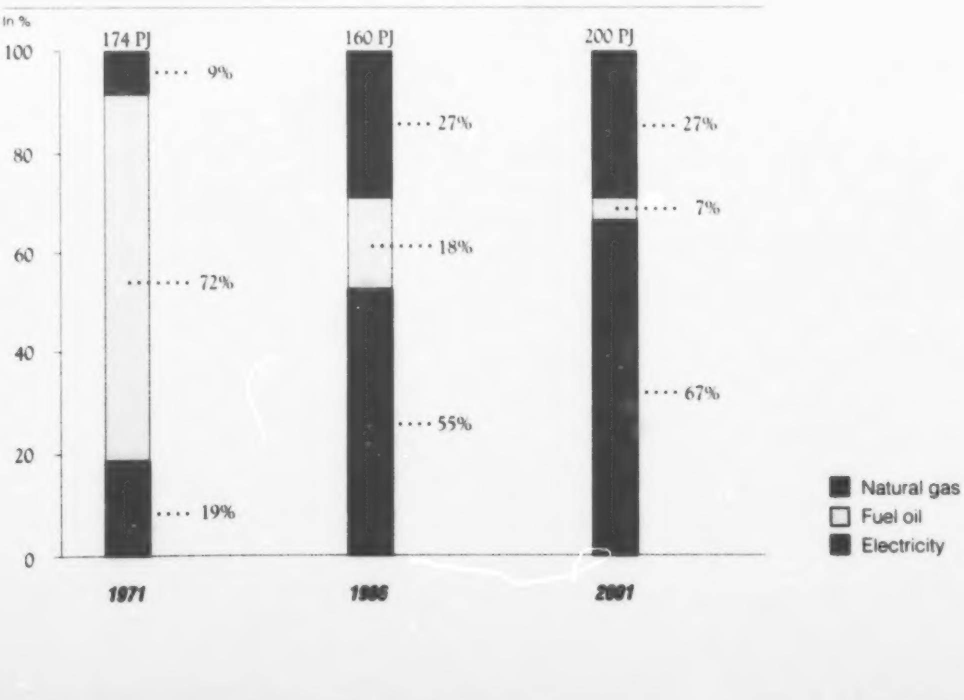
From 1986 to 2001, the oil substitution markets will be virtually saturated and will play only a marginal role in the general sector's growth. The use of electricity for space and water heating in new buildings has increased, except in areas served by natural gas. Overall, the large share of electricity in heating new buildings, combined with demographic and economic growth, accounts for much of the growth of 11.5 terawatthours forecast for the period.

FIGURE 11
HYDRO-QUÉBEC SALES TO THE GENERAL SECTOR



Electricity's penetration of the market for heating new buildings and those heated with oil enabled it to increase its share of the energy mix from 19% in 1971 to 55% in 1986. The figure should reach 67% in 2001, when natural gas will account for 26% and oil 7%. Furthermore, the efficiency of electricity and energy conservation helped bring consumption by the commercial sector down from 174 petajoules in 1971 to 160 petajoules in 1986. This is an average annual drop of 0.6%. From 1986 to 2001, these factors will be less important, and energy consumption by this sector should rise from 160 to 200 petajoules, for average annual growth of 1.5%.

FIGURE 12
ENERGY MIX IN QUÉBEC'S COMMERCIAL SECTOR



Industrial Sector

From 1971 to 1986, Hydro-Québec's sales to the industrial sector increased by 14.1 terawatthours. Of this increase, 4.6 terawatthours was to the pulp and paper industry, and 2.6 to smelting and refining (including 2.2 to new aluminum smelters). Economic growth accounted for the remaining 6.9 terawatthours.

In 1986, Hydro-Québec sold 36.5 terawatthours of firm electricity to the industrial sector. This consisted of 11.7 terawatthours to the pulp and paper industries, 3.0 to aluminum smelters, 3.2 to other smelting and refining industries and 18.6 to all other industries. Moreover, 12.3 terawatthours of surplus electricity was sold for boilers. The boiler program was developed in 1983 to sell temporary surpluses. Most of the four-year contracts expire in 1988 and will not be renewed.

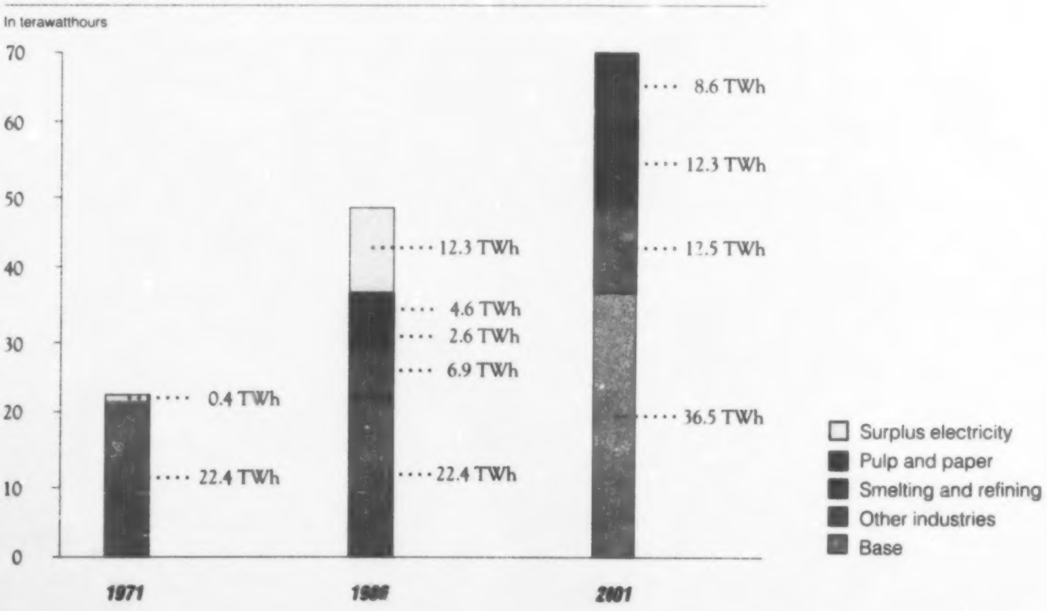
To industrial consumption must be added the electricity produced by independent producers, such as Alcan. This totaled 16.9 terawatthours in 1971 and 20.5 terawatthours in 1986.

Hydro-Québec sales of firm electricity to the industrial sector from 1986 to 2001 will increase by 33.4 terawatthours — more than double the increase of the preceding 15 years. Because of Québec's strong economic infrastructure and the relatively low price of electricity, new aluminum, magnesium and other smelting and refining plants should account for 12.3 terawatthours of this increase.

Modernization and increased production by the pulp and paper industry will account for an additional 8.6 terawatthours. Economic growth and the greater use of electrotechnologies will account for a further 12.4 terawatthours, shared among all other industrial groups.

Energy growth held at 1.2% per year from 1971 to 1986, in spite of the replacement of oil-fired boilers with electric boilers which are more efficient in generating steam. This increase contrasts with the situation in the residential and commercial

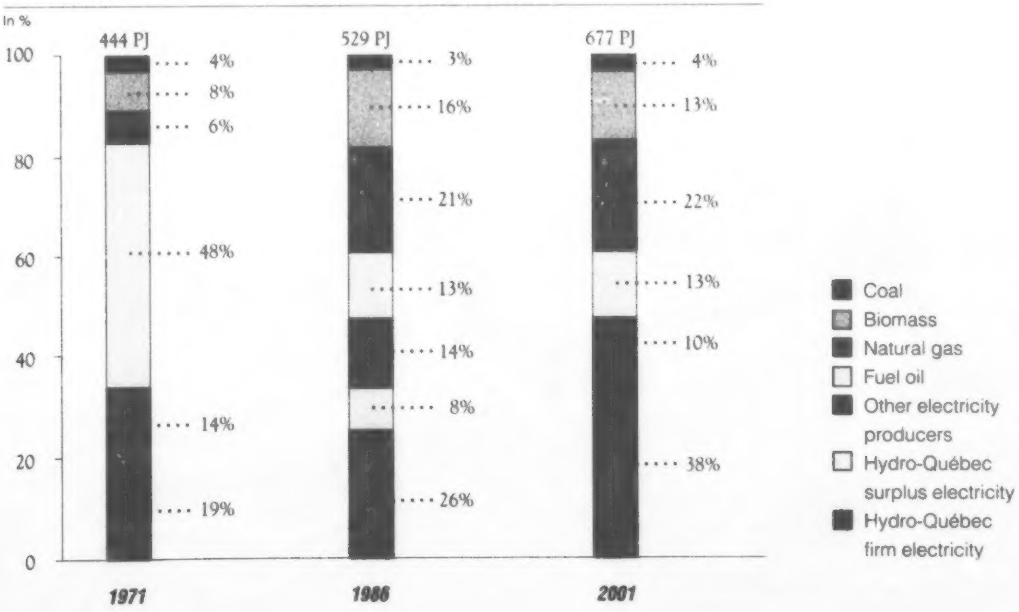
FIGURE 13
HYDRO-QUÉBEC SALES TO THE INDUSTRIAL SECTOR



sectors, where the replacement of oil heating systems with more efficient electricity has reduced energy needs. The explanation lies in the fact that heating is a lesser requirement in the industrial sector, which, moreover, uses fuels more efficiently.

From 1986 to 2001, energy needs in the industrial sector will grow somewhat faster than in the previous fifteen years. Forecasts are for growth of 1.7% per year because of economic expansion and the opening of plants in large-power industries.

FIGURE 14
ENERGY MIX IN QUÉBEC'S INDUSTRIAL SECTOR



4.2 Orientation of the 1988-1990 Marketing Plan

To maintain and improve electricity's share of Québec's energy mix and to best satisfy customer needs, the 1988-1990 marketing plan is based on three major orientations: improved customer service, selective market development and a balanced rates policy.

4.2.1 Customer Service

In recent years, Hydro-Québec has undertaken a major operation to improve its relations with all categories of customers. The first stage consisted of being more attentive to customers. The utility sought a better understanding of customer needs and expectations so that it would be in better position to satisfy them. This provided the impetus for a complete review of its business practices.

The review involved a number of areas, including sales and promotion, customer inquiries, customer records, agreements, metering apparatus, meter reading, billing and customer payment.

The challenge of the next few years will consist of gradually applying modifications to these business practices on the basis of customer needs and the utility's interests. In order to pursue this major reorientation toward customer needs, Hydro-Québec will concentrate on informing and mobilizing its employees.

Hydro-Québec will also pursue its efforts to improve the quality of electricity service, an on-going priority. Continuity of service is discussed at length in Chapter 6, Power-System Operation. As with customer relations, achieving this goal depends largely on the daily actions of some 15,000 employees, whose goal is to offer service of the highest quality.

OBJECTIVE 1

Maintain personalized relationships with the various customer categories in order to increase customer satisfaction and support efforts to maintain and develop electricity markets.

COMMUNICATION STRATEGIES

1. Increase contacts with customers, especially by continuing the dialogue begun with consumer associations.

2. Stress the involvement of Hydro-Québec employees in customer service.

SALES STRATEGIES

1. Revise commercial terms for supplying electricity.

2. Support marketing efforts through increased assistance for commercial and industrial customers.

AFTER-SALES SERVICE STRATEGIES

1. Improve systems for communicating with customers and introduce a recourse mechanism for dissatisfied customers.

2. Improve revenue-collection methods.

4.2.2 Selective Market Development

Hydro-Québec seeks to continue developing markets that offer the profitability needed for its financial equilibrium, while doing its utmost to consolidate those acquired in recent decades. To do this, Hydro-Québec must continue to offer quality products and services adapted to the needs of its customers. In recent years, Hydro-Québec has promoted energy conservation measures. In the future, it will continue its efforts to promote the wise use of electricity through its market development strategies.

New markets will replace those such as the boiler program, opened temporarily to sell substantial electricity surpluses. Such sales will decrease as current contracts expire.

Hydro-Québec will continue its efforts to acquire markets that promote the use of electricity in off-peak periods. Such sales limit the need to construct new peak-load installations and thus lower overall generating costs, as well as reducing the environmental impacts of installations at their source. This strategy helps slow the growth of rate increases for all customers and offers a clear advantage to those customers who opt for these products.

Specific Programs

Residential and Farm Sector

Electricity already holds a prime place in the residential and farm sector. Additional expansion depends on increases in the number of households, expected to occur more slowly between now and 2001 than between 1971 and 1986. If the use of electricity is to respond increasingly to efficient management criteria, the marketing program must seek to maintain and expand the stock of residential dual-energy installations.

In order to maintain the satisfaction and loyalty of dual-energy customers, Hydro-Québec proposes two main approaches. These will preserve dual-energy installations in the long term and persuade customers to use their dual-energy systems in automatic mode. The first consists of establishing adequate after-sales service, while the second is to offer interested customers a rate incentive to heat with electricity during off-peak hours and oil during peak hours.

General Sector

The dual-energy program is also available to the general sector. And the utility promotes other off-peak usage, to favor the use of less costly generating equipment. By promoting off-peak consumption, Hydro-Québec helps its customers to benefit fully from the comparative advantages of hydroelectricity.

Industrial Sector

Interruptible Power Program. Hydro-Québec offers its industrial customers an interruptible power program that features discounts for interrupting a portion of consumption during critical periods.

In 1987, the utility introduced new mechanisms that will allow it to gradually increase interruptible power stock from 500 to 2,000 megawatts by 1996. This program reduces both customer and Hydro-Québec costs by avoiding the installation of new peak-load equipment.

Risk and Profit-Sharing Program. Sharing of risks and profits, available since 1986, helps retain major investments in Québec and attract new ones. The concept developed by Hydro-Québec opens a new avenue to those industrial customers for whom electricity is a major production cost. This program seeks to increase the share of electricity in the industrial market and help expand Québec's industrial base.

The utility intends to continue this strategy in 1988 and will determine its position on the main areas covered by these agreements. The main aspects will be how the customer operates, the scale of required investments, the duration of the running-in period and the economic cycles the customer is likely to experience.

At the end of 1987, eight of these agreements were in force, involving a total of more than 800 megawatts to the smelting and refining, chemicals and pulp and paper industries.

Electrotechnology Implementation Assistance Program. The fundamental purpose of this program is to introduce electrical technologies that are highly efficient in industrial processes in order to increase Hydro-Québec's sales of electricity and improve the competitiveness of industries.

The goal of 300 megawatts should be achieved and even exceeded, since contracts signed at November 30, 1987 totaled 261 megawatts, or 87% of the program's objective.

As part of this marketing program, Hydro-Québec has devoted substantial efforts to research, development and demonstration of electrotechnologies, in collaboration with industry and certain research agencies. The initiative has made it possible to develop a network of partners that should be extremely profitable for the penetration of electrotechnologies in the future.

In the next three years, Hydro-Québec hopes to increase sales resulting from electrotechnologies by about one terawatthour per year. This represents annual revenue of some $30 million.

Continued penetration of industrial electrotechnologies. This strategy is based on continuing the present electrotechnologies program, which expires on May 1, 1988, in terms of selective market development to achieve the profitability that financial equilibrium requires. This strategy will be supported by research and development to promote the application of the most productive electrotechnologies in high-potential industrial processes, for the mutual benefit of industry and Hydro-Québec.

Industrial Development. Since June 1985, Hydro-Québec has been actively involved in industrial development to win new firms for Québec, with emphasis on large-power industries. As part of this program, Hydro-Québec works in association with Québec's industrial development agencies to use its marketing programs to attract potential foreign investors.

OBJECTIVE 2

Maintain and selectively develop Québec markets, in order to offer advantageous options that reflect customers' individual needs and at the same time reduce the cost of supplying electricity.

STRATEGIES

1. Expand Québec's industrial base and increase the role played by electricity through the promotion of electrotechnologies.

Promote risk and profit sharing with customers for whom electricity is a major production cost if this is necessary for their survival or location in Québec.

Continue promoting industrial electrotechnologies.

This strategy is based on the extension or revision of the existing electrotechnologies program, diversification of demonstration cases and research on new electrotechnology applications in association with industry (manufacturers, research centres, universities, industrial associations, etc.).

Promote Québec's electricity and other socio-economic advantages in order to persuade foreign manufacturing firms to invest in Québec.

2. Promote the consumption of electricity during off-peak hours by reducing or shifting consumption that now occurs in peak periods.

Expand interruptible power stock.

Encourage industrial customers to join the new interruptible power program whose goal is to gradually increase interruptible power stock available from 500 to 2,000 megawatts by 1996.

Ensure that the residential dual-energy stock is maintained and expand it to 150,000 units.

Since the end of 1987, Hydro-Québec has offered residential customers the Dual-Energy Plus program, which allows savings through a time-of-use rate. It also includes, with a grant from Hydro-Québec, insurance for heating system maintenance and fuel oil supply.

Encourage surplus energy customers, especially those using light fuel oil, to join the dual-energy program.

Continue the pilot project on the remote control of residential loads, to determine its technical and commercial potential as a method of consumption management.

This project has been underway since fall 1986 and will continue until fall 1988. Three systems, using radio waves, cable and telephone, are being compared, and their acceptability as a method of consumption management is being measured in a sample of 700 residential customers on Montreal's South Shore.

4.2.3 Balanced Rates Policy

Electricity rates must make it possible to obtain a sufficient return on all Québec markets to provide the margin of maneuver needed to cope with the inevitable fluctuations of the economic and financial context without causing major problems for customers.

Moreover, Hydro-Québec's rates policy expresses the desire for electricity rates to more clearly reflect the costs incurred to supply each of the major rate categories.

At this time, there is a substantial disparity between the cost of supply and the price of electricity. This disparity is clearly apparent in 1987 from an examination of the relative share of supply costs from each of the major rates categories compared to the relative share of revenue each one generates. Rate L, applicable to large-power customers, presents a balance between its cost and revenue, but the same is not true for other categories. Rates G and M (small-power and medium-power) provide a share of revenue substantially higher than their share of the cost of supply, while the D rate of residential customers does just the opposite.

It is important to reduce these variances so that each market provides its fair share. However, this operation will take place gradually, in order to avoid rate shocks. In introducing corrections, Hydro-Québec must take into account the general economic situation and the prices charged by its competitors. It will therefore spread the return to balanced rates over several years.

TABLE 7
SHARE OF COST OF SUPPLY AND REVENUE GENERATED BY PRINCIPAL RATES CATEGORY 1987

Rates category	***Share of cost of supply***	***Share of revenue generated***
D (residential)	51.5%	44.9%
G (small-power)	12.8%	15.7%
M (medium-power)	16.8%	21.0%
L (large-power)	18.9%	18.4%

OBJECTIVE 3

Ensure that overall rate increases approximate the projected rate of inflation in order to create the margin of maneuver necessary for the utility's financial equilibrium. Increases will be modulated to reduce cross-subsidization and gradually reflect the costs of supply, and thus support the development of profitable markets.

STRATEGIES

1. Recommend, for 1988, changes in the Rates Bylaw that comply with the principles of the above objective. This recommendation is discussed in a separate publication entitled *Mémoire sur la tarification proposée pour 1988*.

   In the preparation of this Development Plan, average rate increases of 4.5%, effective May 1, were assumed for 1988, 1989 and 1990.

2. Continue to develop rates options, taking customer operating methods into account, that promote the use of electricity during off-peak periods and constitute alternative solutions to standardized rates.

4.3 Target Scenario for Québec Electricity Demand

The demand forecast is a concrete expression of Hydro-Québec's orientations, objectives and marketing strategies. It is described in the target scenario, the term chosen to designate a scenario which while based on medium demographic and economic growth and change in the energy context, reflects Hydro-Québec's objective of maintaining or even increasing the stock of residential dual-energy installations and of adapting rates in a way that will guide customers toward more efficient use of electricity. These measures will reduce long term needs for power by 1,200 megawatts.

Sales of electricity in Québec[1] consist of firm sales plus sales of surplus electricity used mainly to generate steam in the industrial sector.

Sales of Firm Electricity in Québec

Projected average annual growth from 1986 to 2006 is 2.7% or 3.6 terawatthours per year, reaching 176.0 terawatthours in 2006. However, there will be a constant reduction in the rate of growth, from the combined impact of demographic slowdown and saturation of the oil-replacement market for heating residential and commercial units. The annual rates will drop from 4.5% from 1986 to 1991 to 2.8% from 1991 to 1996, 1.9% from 1996 to 2001, and 1.6% from 2001 to 2006.

The rate of growth from 1986 to 2006 remains the same as last year, at 2.7%. However, growth will be much more vigorous at the start of the period: 4.5% from 1986 to 1991, rather than the 3.8% forecast last year. This increase is mainly due to the success of the institutional, commercial and industrial dual-energy programs.

TABLE 8
TARGET SCENARIO
SALES OF FIRM ELECTRICITY BY HYDRO-QUÉBEC IN QUÉBEC

(in terawatthours)

Sector	***1986***	***1987***	***1988***	***1989***	***1990***	***1991***	***1996***	***2001***	***2006***	***Growth 1986-2006 in %***
Residential and farm	40.5	40.4	42.5	43.1	43.8	44.1	48.6	51.8	54.3	1.5
General	22.2	23.9	25.2	26.4	27.1	27.8	31.6	35.2	38.7	2.8
Industrial	36.5	41.7	43.8	46.6	49.7	52.4	62.3	69.9	76.7	3.8
Other	4.2	4.4	4.4	4.4	4.5	4.7	5.2	5.8	6.4	2.0
TOTAL	103.5	110.4	115.9	120.5	125.1	129.0	147.7	162.6	176.0	2.7
Annual growth										
• in TWh	5.9	6.9	5.5	4.6	4.5	3.9	3.8	3.0	2.7	
• in %	6.0	6.6	5.0	4.0	3.8	3.1	2.8	1.9	1.6	

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[1] Details of the assumptions used to forecast demand are presented in a separate publication entitled *LA DEMANDE D'ÉLECTRICITÉ AU QUÉBEC, HORIZON 2006.*

Hydro-Québec's forecast of 2.7% growth lies within the 1.9% to 3.3% range, which makes it possible to assess the nature of the impact of a variation in demand on the utility's planning and development activities. This range is slightly skewed in relation to the target scenario because certain markets are more likely to fall than rise. Moreover, a number of Hydro-Québec's markets are approaching saturation. In the residential and farm and general sectors, improved efficiency of heating systems from substantial penetration of heat pumps, for example, appears more likely than an increase in unit heating consumption. A major part of industrial growth depends on large-power users. The unpredictable world economic and energy scene, plus fierce international competition for these industries, could delay their introduction to Québec.

The strong demand scenario implies more sustained world economic growth, in which Québec participates, and more positive demographic growth. The weak demand scenario assumes world economic growth that is less favorable for Québec exports of products and services and demographic growth affected by a net out-migration.

Impact on Power

The success of the dual-energy programs makes it possible to substantially reduce power needs on very cold days. Peak shaving will be some 3,450 megawatts. This demand, which hovers near 10% of total demand, can generate rapid variations when temperatures are close to load-shedding levels, and these must be planned for. Added to dual-energy programs, interruptible power contracts bring peak shaving to more than 5,000 megawatts and allow Hydro-Québec to postpone new peak-load generating facilities representing an equivalent amount.

FIGURE 15
SCENARIOS FOR SALES OF FIRM ELECTRICITY BY HYDRO-QUÉBEC IN QUÉBEC

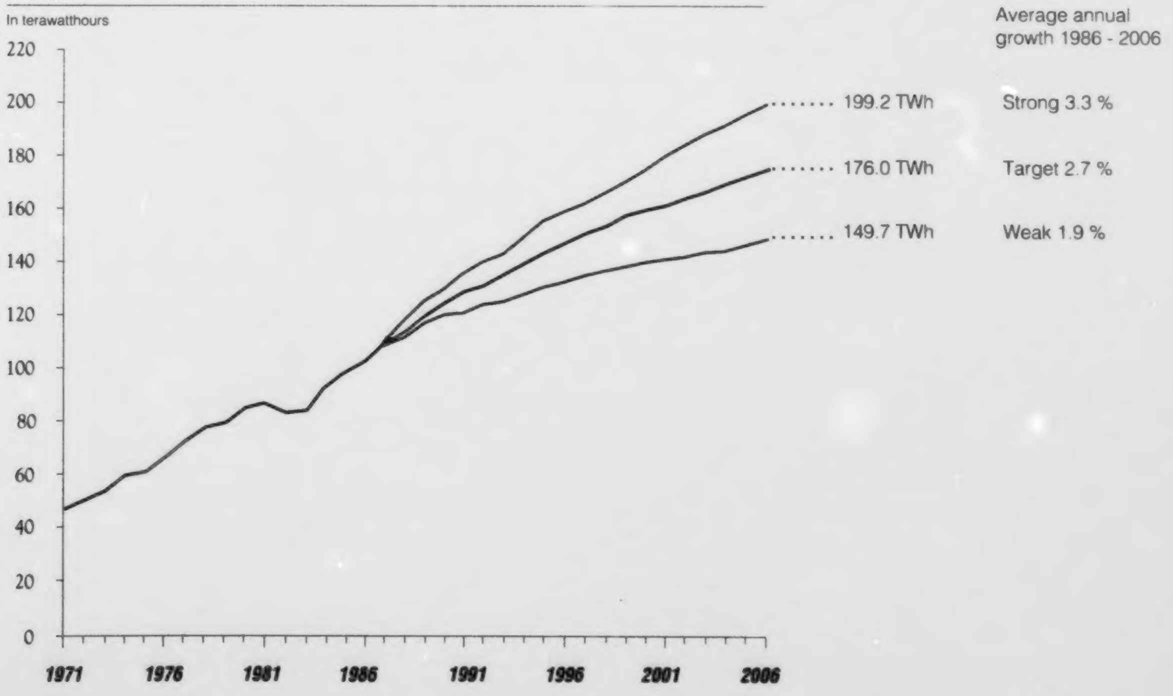
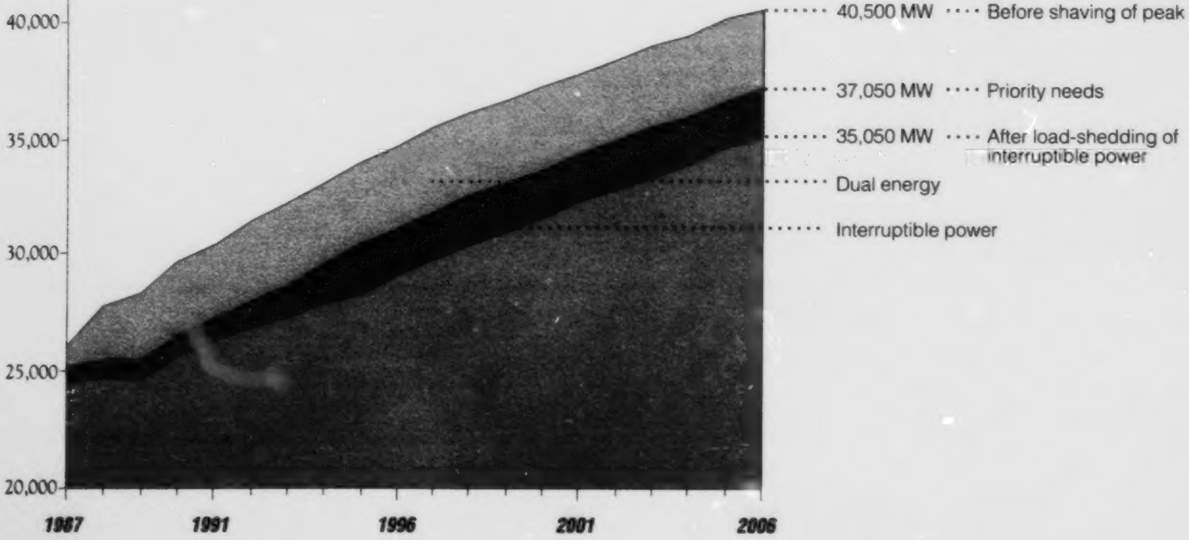


FIGURE 16
PRIORITY NEEDS - TARGET SCENARIO



Sales of Surplus Electricity in Québec

More than 400 agreements signed as part of the boiler program represent installed capacity of 3,207 megawatts. Consumption was 12.5 terawatthours in 1987, and is expected to be 11.4 terawatthours in 1988 and 0.7 in 1989.

After 1988, about 0.3 terawatthours of these sales in the general sector should subscribe to the dual-energy rate and be integrated into firm energy sales. In the industrial sector, a portion of the market may purchase firm supplies with the introduction of efficient electrotechnologies for certain processes.

Any surplus electricity sales after these agreements expire will be interruptible and seasonal. Their levels will be dictated by variations in run-off, the growth of firm sales in Québec, export sales and price levels and the level of Québec interest in surplus electricity. In view of these factors, additional sales of surplus electricity of 1.5 and 0.4 terawatthours in 1989 and 1990, respectively, have been retained in the Plan.

TABLE 9
HYDRO-QUÉBEC SALES OF SURPLUS ELECTRICITY IN QUÉBEC

(in terawatthours)

	1986	***1987***	***1988***	***1989***	***1990***
General sector	1.4	1.3	1.1	0.0	0.0
Industrial sector	11.1	11.2	10.3	2.2	0.4
Neighboring systems in Québec	1.2	1.3	0.0	0.0	0.0
TOTAL	13.7	13.7	11.4	2.2	0.4

5. THE DEVELOPMENT OF EXTERNAL MARKETS

. . . .

Development Prospects for External Markets

The expansion of its mission in 1983 enabled Hydro-Québec to intensively explore the avenues offered by external markets. At that time, the utility adopted the orientation of achieving a lasting breakthrough on export markets, in addition to its sales of surplus electricity.

To this end, Hydro-Québec devised and implemented a three-stage external market development strategy. Whereas the first stage concentrated on the sale of the surpluses generated by its existing facilities, the objective of the second and third stages is to sell blocks of firm power and energy large enough to require the construction of generating and transmission facilities that would otherwise be required at a later date to meet Québec's domestic needs. As part of the development of these last two stages, the utility must ensure that it has a level of profitability equivalent to that demanded by shareholders in the private sector for comparable projects, while taking into account the additional costs of supply and risks involved in such a construction program. The second stage consists of projects to satisfy needs for power in the 2001 horizon that require a decision by the neighboring systems within a few years, while the third stage involves the same firm power and energy market but does not require decisions from these potential customers in the short term.

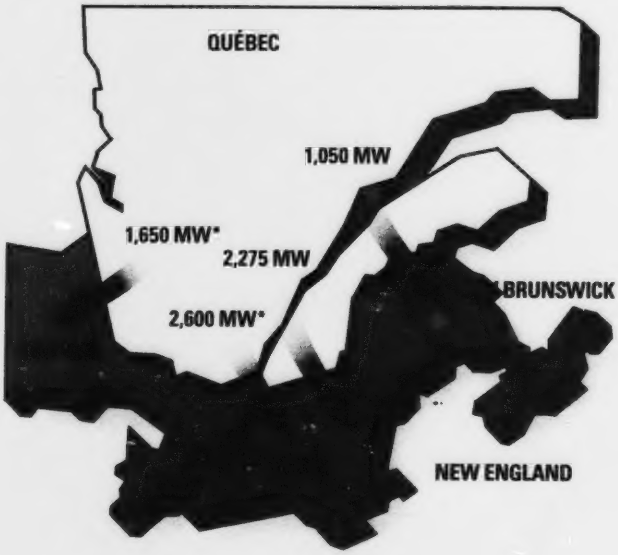
Each of these stages requires a careful evaluation of the market offered by the neighboring systems. The nature and scale of needs that can be satisfied by exports of electricity from Québec must be defined, taking into account the carrying capacity of existing interconnections or the possibilities of new interconnections. The economic advantages of such sales must also be carefully assessed. At the same time, the utility must continue its negotiations with the neighboring systems, either for agreements as part of existing interconnection arrangements or contracts for sales of electricity that would allow the objectives of each stage to be achieved.

5.1 *Interconnections with Neighboring Systems*

Hydro-Québec has interconnections with Canadian systems in New Brunswick and Ontario and US systems in New England and New York State.

MAP 1

INTERCONNECTIONS WITH NEIGHBORING SYSTEMS IN 1990


QUÉBEC
1,050 MW
1,650 MW*
2,275 MW
BRUNSWICK
2,600 MW*
NEW ENGLAND

* The simultaneous interconnection capacity with Ontario and New York State is 3,310 megawatts.

The simultaneous interconnection capacity with these neighboring systems currently totals 5,375 megawatts, but will rise to 6,635 megawatts in 1990 when the interconnection with the New England Power Pool (NEPOOL) is expanded to 2,000 megawatts. This increase will require the construction of a direct-current line from Comerford, New Hampshire, to Sandy Pond in the Boston area. The addition of a 1,000-megawatt interconnection with Maine in 1992 will bring total simultaneous capacity to 7,535 megawatts.

In practice, exports can never equal the maximum interconnection capacity, primarily because of technical considerations involving reliability and availability for maintenance. As well, certain bottlenecks within the US transmission systems limit access to major load centres and prevent existing interconnections from being exploited to the full. The Marcy South project will, however, allow increased use of the carrying capacity with New York Power Authority (NYPA) in 1988. This project, which includes the addition of transmission lines in New York State, will improve access to the New York City area.

Although Hydro-Québec has an interconnection capacity of 2,600 megawatts with New York State, the state's receiving capacity is at present limited to 2,175 megawatts. Hydro-Québec expects that this capacity will rise to 2,600 megawatts after improvements to the New York power grid and the necessary additional studies are made.

TABLE 10
INTERCONNECTION CAPACITY WITH NEIGHBORING SYSTEMS

(in megawatts)

Neighboring system	1988	1990	1992
Canada			
• New Brunswick	1,050	1,050	1,050
• Ontario	1,700	1,650	1,650
	2,750	2,700	2,700
United States			
• New England	965	2,275	3,275
• New York*	2,600	2,600	2,600
	3,565	4,875	5,875
TOTAL	6,315	7,575	8,575
Total simultaneous capacity**	5,375	6,635	7,535
Simultaneous capacity to Ontario and New York State**	3,360	3,310	3,210

* New York State's current reception capacity is 2,175 MW.

** Shared installations allowing deliveries of energy to Ontario and New York State limit the simultaneous export capacity to these two power systems. This constraint varies according to forecast run-off in the St. Lawrence.

5.2 Export Market Development

5.2.1 *First Stage*

Efforts to advance the first stage of external market development intensified in the early 1980s with the advent of major surpluses from an unexpected decline in the growth rate of Québec demand. The electricity utilities in the neighboring regions also found themselves with surplus generating capacity. However, since their generating facilities consisted in large measure of oil- and coal-fired units, which have high variable costs of production, these utilities were interested in reducing costs by replacing some of the oil- and coal-fired generation with imports of hydroelectricity.

Meanwhile, to sell its own surpluses, Hydro-Québec had focused its attention on developing the fuel-replacement markets. There was a large potential market available, since several of the electricity utilities in neighboring regions were heavily dependent on oil and therefore exposed to high oil prices.

To reach these markets, Hydro-Québec had to expand its interconnection capacity. An additional 1,000 megawatts with New York State and Ontario was added in 1984, 500 megawatts with New Brunswick and 200 with Vermont between 1984 and 1986, and 690 megawatts with New England in 1986. This resulted in a 50% increase in export sales between 1983 and 1987, boosting them from nearly 20 to about 29 terawatthours per year.

This first stage of market development is essentially completed. In addition to the installation of the required infrastructures, Hydro-Québec has negotiated new interconnection arrangements with several neighboring systems, made agreements as part of these arrangements and signed contracts.

TABLE 11
MAIN FIRM EXPORT COMMITMENTS - STAGE ONE

Neighboring system	**Commitments**	**Average annual energy (in TWh)**	**Duration**
New York Power Authority	800 MW of diversity power and associated energy	3.0 *	1979-1998
St. Lawrence Power Company	50 MW of firm power and energy	0.4	1984-1989
Vermont Department of Public Service	150 MW of firm power and energy	1.1	1985-1995
Citizens Utilities	Firm power and energy	0.2	1985-1990
Vermont Joint Owners	50 MW of firm power and energy	0.4	1987-1990
New Brunswick Electric Power Commission	Firm energy	3.0 **	1988-1994
New England Utilities	Firm energy	7.0	1990-2000

* The agreement with respect to associated energy is regularly renegotiated; the current agreement expires in 1988.

** 3 TWh/year for the contractual years 1988 to 1992 and 2 TWh/year thereafter.

Deliveries of electricity under these various contracts and agreements come essentially from the surpluses generated by Hydro-Québec's existing facilities and, as a result, have not required any significant changes in the construction program.

Future Surpluses

Hydro-Québec forecasts export sales of 63 terawatthours of surpluses after 1987. In last year's target scenario, Hydro-Québec forecast 132 terawatthours for the same period. The decrease is mainly due to forecasts of higher sales on Québec markets, increases in firm export sales and lower than average water levels in 1987.

Unlike past years, when Hydro-Québec had to sell its surpluses in order to avoid spillage, the utility is now in a position to select the best markets. Hydro-Québec can store its surpluses and sell them later on the most lucrative markets. It can also guarantee blocks of energy or make energy available at heavy consumption times for neighboring systems, thereby enhancing the value of the product for the buyer.

Hydro-Québec signed a number of short term agreements in 1987 with Niagara Mohawk Power Company, New England Power Pool (NEPOOL) and New Brunswick in order to increase the value of its surpluses. The revenue from these sales is estimated at more than $85 million.

Fuel-replacement Market

Given the present energy context, the replacement of oil-based generation remains the largest and most profitable market for Hydro-Québec in the short term. Even with the construction of new generating stations, neighboring systems will continue to depend on existing oil-fired generating stations for a major portion of their supply.

At this time, the needs for generation from oil-fired facilities for all neighboring systems are estimated at about 75 terawatthours per year before any fuel-replacement transactions. Some of these needs cannot be replaced because of the operating constraints on the electric power systems. These include the need to maintain a minimum level of local generation to allow rapid restoration of loads and to maintain electric voltage or generate steam for industrial needs.

The replacement of output from coal-fired generating stations represents the residual market for surplus energy sales. Because variable production costs of coal-fired facilities are lower, this market is less profitable, and it will be quickly abandoned as surpluses are reduced.

5.2.2 Second and Third Stages

The second and third stages are substantially different from the first stage.

Whereas during the first stage, Hydro-Québec sought to maximize the revenue from the sale of surpluses from its existing generating facilities, in the second and third stages, the utility has decided to become involved in selling firm electricity for export. To satisfy its commitments, Hydro-Québec must bring forward its generating and transmission construction program.

The utility is no longer limited to the fuel-replacement market. Replacement of new base-load facilities by sales of firm power and energy appears to be the most appropriate option for achieving a permanent breakthrough on the export market. This option assures the utility of guaranteed revenue from electricity sales so that it can make the major investments required to satisfy its commitments.

This option also offers an attractive profit margin for Hydro-Québec and its customers, based on a comparison of the costs of commissioning and operating new base-load facilities in Canada and the United States with the costs of earlier construction of hydroelectric facilities by Hydro-Québec. This profit margin would also be sufficient to cover the contingencies likely to arise in such a project.

Furthermore, in addition to its cost-effectiveness, this orientation offers other advantages for the neighboring systems. Importing electricity from the Hydro-Québec system requires little investment for customers, compared to the cost of building new base-load facilities, yet offers the same security of supply. Moreover, hydroelectricity is generally considered to have less environmental impact than generation by coal-fired or nuclear facilities.

The Market for Firm Power and Energy

The total export market has been evaluated on the basis of data for the period from 1988 to 2001 contained in the most recent development plans of the neighboring systems.

In these plans, the neighboring systems have adopted a series of assumptions with respect to the growth of their internal demand, measures for consumption management, cogeneration, growth of the installed capacity of independent producers, extension of the service life of existing generating facilities, the re-commissioning of mothballed plant, construction of new base-load and even peak-load facilities, and electricity imports.

Increased demand for electricity in the neighboring systems will be satisfied for some time by the addition of nuclear generating stations now under construction and the increased use of existing oil-fired facilities. These additions to capacity will temporarily increase existing power surpluses. Nevertheless, these surpluses will be gradually absorbed by the forecast increase in demand. Other means, such as consumption management and cogeneration, will have to be implemented progressively between now and the end of the century to satisfy forecast needs for power and then energy.

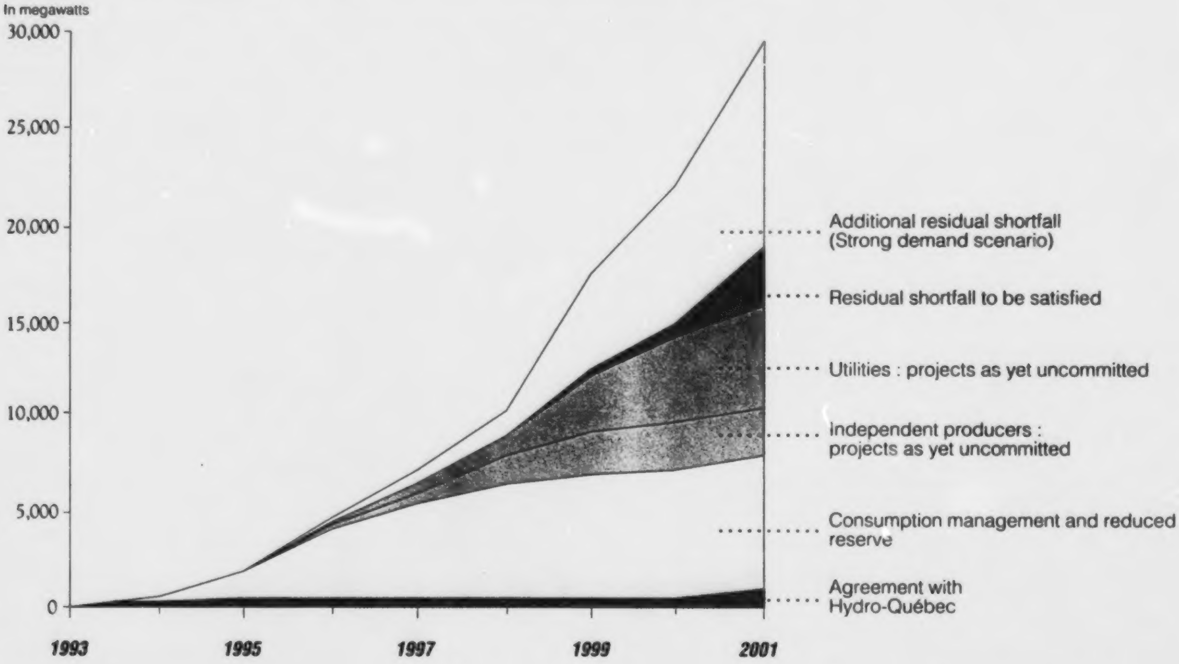
In a medium-demand scenario, above and beyond the forecast additions of capacity from the completion of projects in progress, a shortfall of more than 18,700 megawatts, out of total forecast demand of about 105,000 megawatts, will have to be filled in the 2001 horizon.

Steps have been planned to provide nearly 16,000 of this total of 18,700 megawatts. The neighboring systems are explicitly counting on imports of 900 megawatts in the 2001 horizon, under the agreement with Central Maine Power Company. They expect to be able to implement consumption management programs that will reduce power needs by just over 7,000 megawatts in this horizon. They have planned about 8,000 megawatts of uncommitted projects by independent producers and public utilities. A residual shortfall of about 2,700 megawatts remains to be filled in this horizon.

The market accessible to Hydro-Québec includes this residual shortfall of 2,700 megawatts as well as a portion of the uncommitted projects estimated at about 4,000 megawatts, that is, 200 megawatts from independent producers and 3,800 megawatts from the utilities. As-yet uncommitted projects that could be replaced by imports from Hydro-Québec consist mainly of base-load projects, including combined-cycle generating facilities using Canadian natural gas, and projects for extending the service life of oil-fired facilities. A total sales potential of 7,600 megawatts, including the agreement for 900 megawatts with Central Maine Power Company, can be seen in the 2001 horizon.

FIGURE 17
SATISFACTION OF PROJECTED NEEDS ON NEIGHBORING SYSTEMS

(medium demand scenario)



The accessible potential defined in this way assumes that consumption management programs will achieve their intended goals. It also assumes that all projects in progress will be completed. This means that the program for extending the service life of the coal-fired stations will be carried out and that the new nuclear generating stations at Seabrook (New Hampshire) and Shoreham (New York State) with a total installed capacity of 2,000 megawatts, will be put in service.

Furthermore, if the demand assumptions used by the neighboring systems in their development plans are revised upward by just half a percentage point, the residual shortfall of 2,700 megawatts could rise as high as 10,300 megawatts in the 2001 horizon. Given the market potential of 4,000 megawatts from uncommitted projects, the total accessible market would be about 14,300 megawatts.

Beyond the 2001 horizon, power shortfalls are likely to increase rapidly, leaving room for major exports for Hydro-Québec.

TABLE 12
SALES POTENTIAL IN THE 2001 HORIZON

(in megawatts)

	Plan 1988-1990	***Plan 1987-1989***
Residual shortfall*		
New York	0	0
New England	2,700	5,200
New Brunswick	0	300
Ontario	0	400
Total	2,700	5,900 **
Portion of projects as yet uncommitted	4,000	1,600
Agreement with Hydro-Québec	900	---
TOTAL	7,600	7,500

* As indicated in the plans of the neighboring systems.

** As shown in Hydro-Québec's Development Plan 1987-1989, Horizon 1996

Realization of the Second Stage of Development

The Objective

In the second stage, Hydro-Québec seeks to use exports to replace the projects the neighboring systems would have to undertake to satisfy their power needs in the 2001 horizon and which therefore require a decision on their part in the next few years. Given this decision timetable and the accessible potential, Hydro-Québec has set as its goal the sale of 3,500 megawatts of firm power and energy. Favorable circumstances on external markets, combined with increased Québec demand, could raise this figure to 4,500 megawatts, as could more detailed studies on facilities.

The utility will optimize its existing interconnections. It will also ensure that the interconnections have sufficient margins to enable it to sell occasional surpluses from unusually high run-off or low demand in Québec, as well as to satisfy mutual assistance arrangements between Hydro-Québec and its neighboring systems.

The development of external markets must offer profitability corresponding to shareholders' expectations in the private sector for similar projects, taking into account the additional costs of supply and the risks associated with such development.

Realization

As part of the second stage, Hydro-Québec has developed a product and price formula whose features are flexible and adapted to customer needs.

Sales of electricity in the form of firm power and energy can be negotiated to allow both buyer and seller a degree of flexibility. The price formula is based on a negotiated base price, subject to indexing and interest-rate formulas.

Hydro-Québec has initiated and continued negotiations with neighboring systems that have already resulted in a contract, a letter of intent, and a memorandum of understanding. The letter of intent signed in February 1987, should lead, in 1988, to a contract with Central Maine Power Company. Hydro-Québec will undertake to deliver 400 megawatts of firm power and energy starting in 1992, to be raised to 600 megawatts in 1995 and 900 megawatts in the year 2000. Deliveries will be gradually reduced starting in 2013, until the contract expires in 2020. As part of this contract, Hydro-Québec will be building a new 1,000-megawatt interconnection.

A second agreement reached in November 1987 led to a contract signed in December 1987 with the Vermont Joint Owners for a 200-megawatt block of firm power and energy for 20 years, starting in 1995. This contract contains a series of options that can be exercised until August 1988 and that could raise this figure to 500 megawatts. It also includes the sale of a 50-megawatt block of firm power and energy between 1990 and 1995.

Furthermore, on January 6, 1988, Hydro-Québec and New York Power Authority (NYPA) signed a memorandum of understanding that should result in a contract for firm power and energy. Under this contract, Hydro-Québec will deliver two 500-megawatt blocks of firm power and energy. The first block will be delivered from 1995 to 2015 and the second from 1996 to 2016.

In the 2001 horizon, these three contracts will represent 2,400 megawatts, or about 70% of the goal of 3,500 megawatts, if all options are exercised.

The future looks highly promising for the utility's export development objective.

The Third Stage of Development

The third stage of development can be distinguished from the second by the decision horizon, the interconnections and the form of financing.

Decision Horizon. In the third stage, Hydro-Québec seeks to replace projects which neighboring systems must undertake to satisfy power needs after 2001 and for which no decision is required in the short term with regard to earlier construction by Hydro-Québec.

The export prospects for the third stage are substantial. The power shortfalls are likely to increase rapidly after 2001, and instead of building new generating plant, the neighboring systems could sign long term import contracts with Hydro-Québec.

Interconnections. The third stage would require the development of additional interconnections on a large scale. Most of these installations would have to be built in densely populated areas; thus these projects could require long lead times because of the large number of parties concerned and the interests they represent.

Financing. Earlier construction of large-scale projects in the third stage would require major borrowings. In order to contain risks and achieve adequate profitability, the utility must continue studies to determine the feasibility of innovative financing that promotes risk-sharing and is adapted to projects of this nature.

5.3 *Objectives and Strategies*

OBJECTIVE 1

Maximize revenue from sales of existing surpluses.

Surpluses from the utility's existing installations will drop off sharply in coming years. Hydro-Québec will then have a sufficient margin of maneuver to allow optimum management of these surpluses and maximization of the revenue from their sale.

STRATEGIES

1. Adjust the price policy to reflect market conditions and reduced surpluses available for sale under interconnection agreements.

2. Pursue the marketing of a portion of existing surpluses, by guaranteeing annual quantities or making energy available at high-consumption times for the neighboring systems. The enhanced value of the product to the buyer should be reflected in a higher price.

3. Pursue studies and the implementation of measures that would optimize the use of existing interconnections.

OBJECTIVE 2

Consolidate the breakthrough on export markets by continuing negotiations with neighboring systems for the sale of firm power and energy totalling 3,500 to 4,500 megawatts.

To achieve this objective, the utility will continue negotiations with interested utilities in order to sign firm power and energy sales contracts. At the same time, the utility will plan the facilities and the additional interconnections required to supply these contracts. It will have to obtain all necessary government approvals from the appropriate agencies.

STRATEGIES

1. Continue negotiations with neighboring systems for long term sales of firm power and energy.

2. Plan the interconnections necessary for the delivery of firm power and energy under the sales agreements that will be signed during the second stage of export development, paying careful attention to environmental concerns.

> Corridor selection that is not only technically acceptable for Hydro-Québec's transmission system but also environmentally acceptable to Québec as a whole will ensure that, at the negotiating table, Hydro-Québec can propose connection points with neighboring systems that are technically, economically, and environmentally attractive.

OBJECTIVE 3

Pursue the sale of firm power and energy to neighboring systems beyond the amounts forecast in the second stage of development.

This stage of development offers a large and promising sales potential for Hydro-Québec. In view of what is at stake, the utility must identify and resolve any problems that can be foreseen at this time.

STRATEGIES

1. Establish price formulas, sales conditions and various contractual terms to develop the export market associated with this stage.

2. Investigate the feasibility of innovative financing for large-scale export projects.

3. Ensure the technical, economic and environmental feasibility of delivering large additional quantities of electricity to major load centres on neighboring systems.

4. Continue discussions with neighboring systems for the sale of firm power and energy in addition to the 3,500 megawatts.

5. Pursue promotional activities with various Canadian and US agencies.

6. POWER-SYSTEM OPERATION

. . . .

To satisfy sales objectives for both the Québec and external markets, Hydro-Québec seeks to improve the operation of its existing plant before building new facilities.

Over two thirds of Hydro-Québec employees are engaged in power-system operation, which covers the generation, transmission and distribution of electricity to all customers. The objective is to improve the quality of service, maintenance and operation as part of this activity.

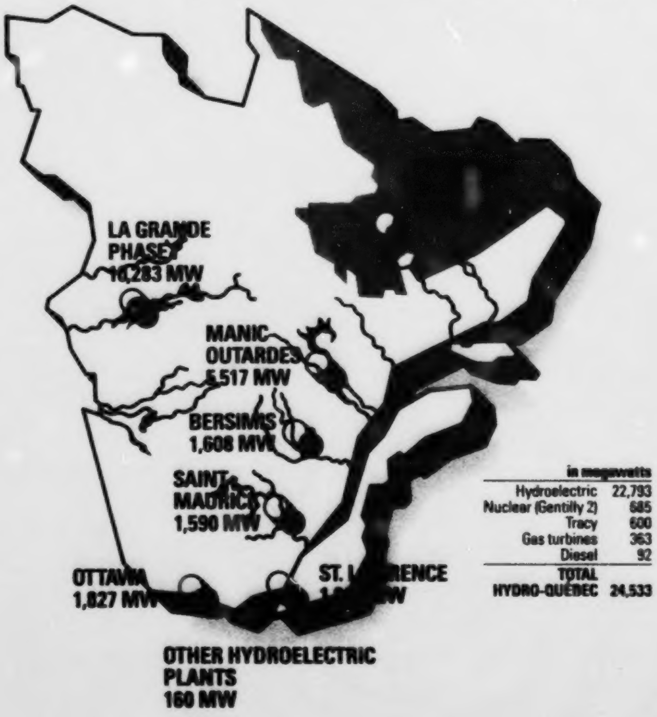
6.1 Present Status

6.1.1 Existing Plant and Capacity

Present installed capacity is 24,533 megawatts. Hydro-Québec owns and operates 80 generating stations, 53 of which are hydroelectric, located throughout Québec. The utility also has access under contract to most of the output of the Churchill Falls generating station.

MAP 2

MAJOR HYDROELECTRIC GENERATING CENTRES (INSTALLED CAPACITY AT JANUARY 1, 1988)


LA GRANDE
PHASE I
10,283 MW
MANIC-OUTARDES
5,517 MW
BERSIMIS
1,608 MW
SAINT-MAURICE
1,590 MW
OTTAWA
1,827 MW
ST. LAWRENCE
OTHER HYDROELECTRIC
PLANTS
160 MW

	in megawatts
Hydroelectric	22,793
Nuclear (Gentilly 2)	685
Tracy	600
Gas turbines	363
Diesel	92
TOTAL HYDRO-QUÉBEC	24,533

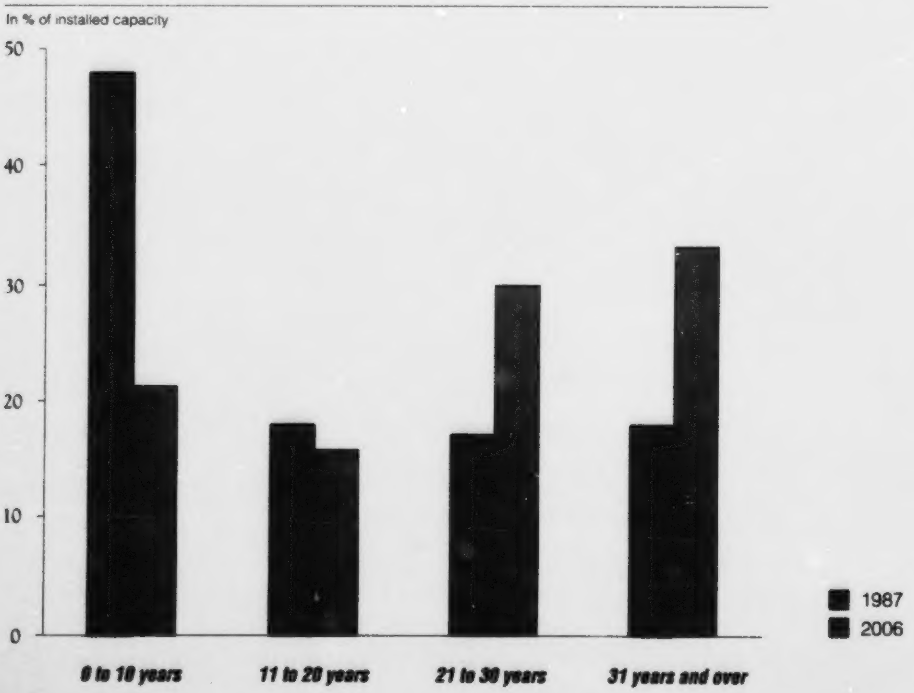
The unexpected slowdown in growth of demand in the early 1980s had until recently left Hydro-Québec in a surplus-storage situation, where additional efforts to manage generation were unnecessary. With the end of this surplus period, Hydro-Québec's fundamental orientation of optimizing the advantage that hydroelectricity represents for Québec means it must optimize both the cost-effectiveness of generating station operation and the efficiency of equipment maintenance. In concrete terms, this requires the review and adaptation of present methods of operating and maintaining generating stations and the improved design of some of their components.

The aging of installations is a matter of current concern for the utility. The average age of installations will rise in the coming decades, given the large generating units commissioned since the early 1960s, and particularly in the 1970s, compared to the capacity of any new equipment the utility might commission in the future.

In 1987, less than 20% of total installed hydroelectric capacity was more than 30 years old. In 2006, this percentage will rise to about 30%.

Moreover, because the oldest generating stations are among the smallest, the utility will have a lot of maintenance work to do on them. By the year 2000, of the utility's 420 dams, at least 20 will be more than 90 years old, and over 60 of the total 306 generating units will be at least 70 years old.

FIGURE18
AGE OF HYDROELECTRIC GENERATING FACILITIES



Added to this potentially problematic situation are increased requirements for improving occupational safety and minimizing the impact of operations on the environment. All these aspects imply greater demands on the utility's human and financial resources.

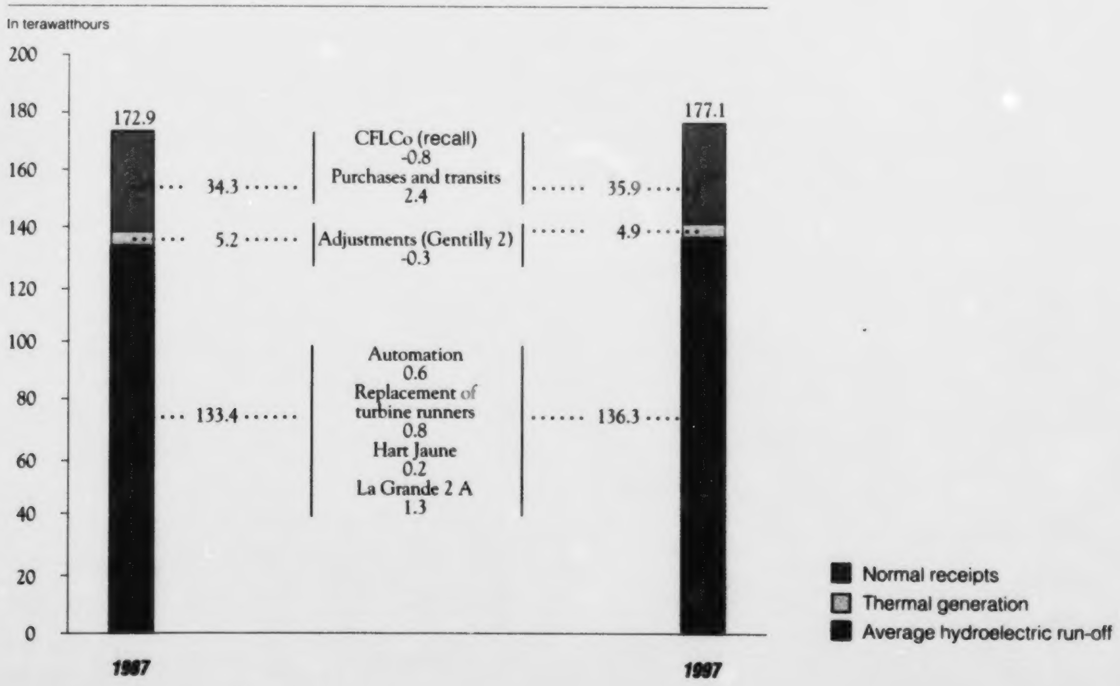
Given these concerns, the utility is continuing its program to upgrade existing facilities. The increase of output resulting from the turbine runner replacement program is now estimated at about 0.4 terawatthours per year, or about 200 megawatts. The gains expected by 2000, cumulatively since the program began, are 1.2 terawatthours per year or about 400 megawatts.

Energy and Power Supply

The average energy output of Hydro-Québec's hydroelectric installations was 133.4 terawatthours in 1987. To this must be added the output of thermal facilities, consisting primarily of Gentilly 2 nuclear generating station which provides about 5.2 terawatthours and the 34.3 terawatthours of electricity received, most of it from Churchill Falls, for an average energy output in 1987 of 172.9 terawatthours.

FIGURE 19

ENERGY SUPPLY FROM EXISTING FACILITIES AND IMPROVEMENTS BY 1997*



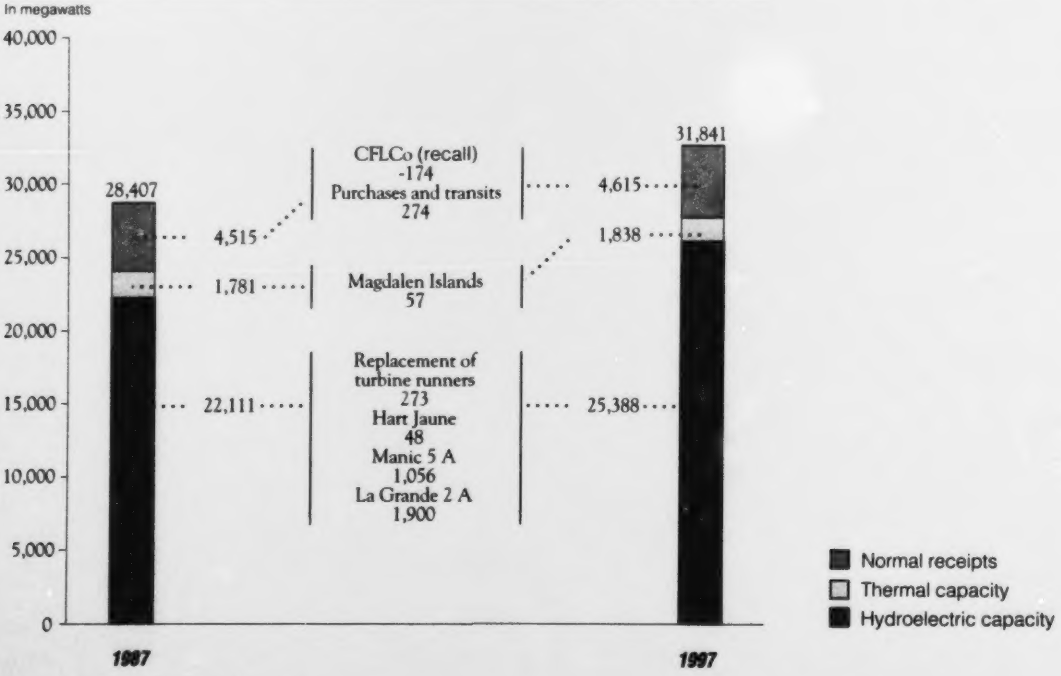
* Excluding unconnected systems.

Hydro-Québec expects to commission additional capacity at Manic 5 in 1989 and La Grande 2 in 1992-93. At the same time, it will be implementing various supply management options that increase the output of its hydroelectric facilities. These involve upgrading existing facilities and greater optimization of hydroelectric generating station management methods.

By 1997, these two measures, combined with increases in electricity received and the commissioning of the additional capacity of La Grande 2, will raise the average energy supply by about 4.2 terawatthours to 177.1 terawatthours per year.

With the commissioning of the additional capacity at Manic 5 in 1989 (1,056 megawatts) and at La Grande 2 in 1992-93 (1,900 megawatts), and the upgrading of existing facilities, the maximum power available will rise from 28,407 megawatts in 1987 to nearly 31,841 megawatts in 1997. It should be noted that available capacity differs from installed capacity due to constraints imposed by hydroelectric generation.

FIGURE 20
POWER SUPPLY FROM EXISTING FACILITIES AND IMPROVEMENTS BY 1997*



* Excluding unconnected systems.

6.1.2 The Transmission and Sub-transmission System

The transmission and sub-transmission system transmits the electrical energy from the generating facilities to the distribution system as well as to neighboring systems and Québec's major industries.

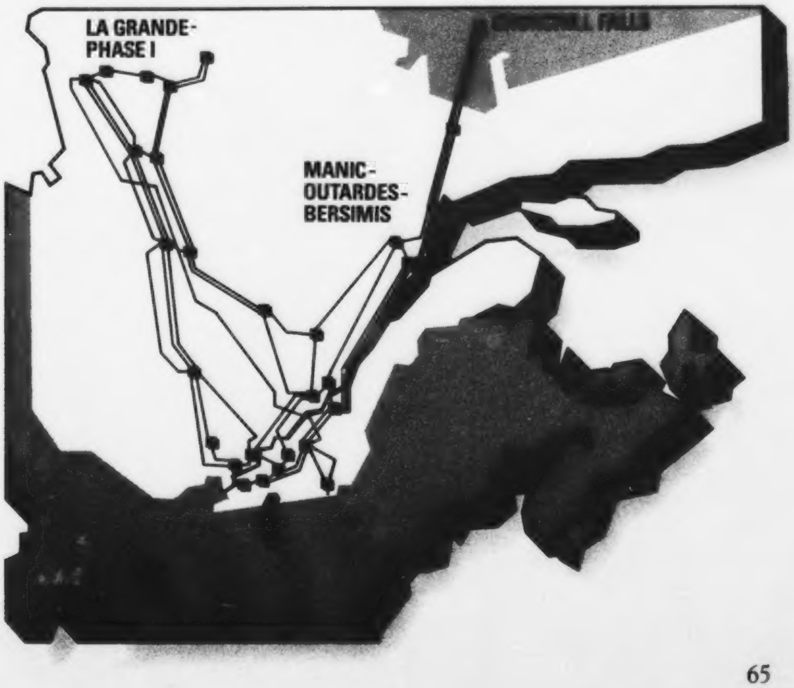
Comprising 33,400 circuit-kilometres in 1987, Québec's transmission and sub-transmission system began life in 1906, with the commissioning of 69-kilovolt lines in the St. Maurice region. From the 1920s, the voltage level was gradually increased to extend the main system to the whole St. Lawrence Valley region and the Saguenay-Lac Saint-Jean - Abitibi system.

To date, there are ten 735-kilovolt lines, five of which are on the North Shore and five in northwestern Québec. At the end of 1986, the first 450-kilovolt direct–current line was commissioned to carry 690 megawatts between the Hydro-Québec system and the neighboring New England Power Pool (NEPOOL) system. This is stage 1 of an interconnection which in its second stage, planned for 1990, will attain a capacity of 2,000 megawatts.

Maintaining such a system implies ongoing development and the installation of new systems. Some of these are the introduction in 1988 of a substation circuit-breaker monitoring system and an automated testing system, the use of an imaging system in helicopter inspection of transmission lines and the development of remote handling systems, also for transmission lines.

In recent years, the transmission system has benefited from major improvements under the service quality enhancement program. However, the aging of facilities will mean continued investment if Hydro-Québec is to maintain the level of availability and service quality achieved by the program.

MAP 3
TRANSMISSION SYSTEM IN 1990



The utility is counting on the neighboring systems accepting new transmission design criteria. This will improve system performance and limit the likelihood of generalized power failure to cases of exceptional circumstances. Some $600 million will be invested between 1988 and 1992 for the implementation of these new criteria.

6.1.3 *The Distribution System and Its Impact on Customer Service*

The distribution system takes over from the transmission and subtransmission systems to deliver electrical energy to Québec's residential, commercial and small industrial customers.

When most remaining private electricity companies were acquired in 1963, there was a substantial diversity in their type of distribution system. Most were systems with operating voltages of 4 and 12 kilovolts, but 13 and 25 kilovolts were also used. Over the following years, in its efforts to rationalize and to deal with load growth, the utility gradually converted its overhead system to 25 kilovolts and its underground system to 12 kilovolts.

The distribution system serves some 2.8 million customers throughout Québec. It consists of 98,700 kilometres of medium-voltage lines, some 5,000 kilometres of which are underground, and about 40,000 kilometres of low-voltage lines. Its size and complexity, plus its large number of components and the severity of climatic conditions, make it the most vulnerable of Hydro-Québec's systems. There have been sustained efforts since 1984, under the service quality enhancement program, to improve continuity of service and the technical quality of the voltage supplied to the customer. Special emphasis has been placed on flexibility of operation and strengthening weak links in the system.

It is worth noting that 50% of distribution system interruptions are due to planned outages for maintenance. A number of modifications have been made to the work code as the result of the coming into force of the *Act respecting occupational health and safety*. These include improvement of safety in live-line working conditions, padlocking and grounding methods, as well as improved access to underground installations, where ventilation has also been improved. These improvements entail an increase in the frequency and duration of planned interruptions.

Given the above, and the system's need for growth, Hydro-Québec will be continuing a number of projects intended to improve the quality of customer service. These include on-line remote control of disconnecting points, customer-demand management by remote control, development of metering equipment and various applications of computers to distribution. Moreover, in order to enhance both customer service and worker safety, the utility is studying new options for the architecture and engineering of future underground distribution systems.

6.1.4 *System Control*

Power-system operation as described above is primarily a matter of maintaining a balance between electricity supply and consumption in conditions of optimum safety, reliability and economy. System control consists mainly of continuous monitoring of relevant system parameters, such as voltage, power and frequency, and of taking the appropriate measures (operations and adjustments) to deal with fluctuations in demand, while respecting the required margins of maneuver. System control therefore involves several aspects simultaneously:

- management of generation and reserves;
- monitoring of system stability and voltage;
- management of exchanges with neighboring systems through the interconnections;
- availability of equipment, especially withdrawals for maintenance.

To rationalize system control while assuring continuity of service at the highest level of reliability, the utility has had to turn to large-scale automation. The automation of the system control centre, the nine regional control centres and 15 distribution control centres, begun several years ago, is continuing. New automatic control devices, computer programs and software, needed for such applications as real-time analysis of system security, forecasting and scheduling of generation and maintenance as well as management of exchanges, are being developed. Efforts will also continue to develop the specialized manpower needed.

6.1.5 *The Telecommunications Network*

The telecommunications network that ensures the communications and remote control of the control centres in the system makes it possible to monitor the behavior of the generating stations, the power grid and the interconnections with neighboring systems. This network then transmits the signals required for action in response to such events as outages, faults or variations in demand, sending them simultaneously to various automatic control devices located in the generating stations, substations and system interconnections. The telecommunications network acts as Hydro-Québec's central nervous system, extending to the very farthest reaches of Québec. And its mobile radio system is used for communication among the maintenance and construction crews working on generating stations, substations and lines.

In order to rationalize the use of the circuits and reduce telecommunication link requirements, the utility has developed a packet data transmission network. The commissioning of the first phase of this project, which began in 1987, linked the Québec City, Montréal and Saint-Hyacinthe network. Subsequent phases will link all regional administrative buildings, head office buildings and system control centres.

6.1.6 *Environmental Protection*

Hydro-Québec operates a vast generating and transmission system, owns substantial amounts of land and uses resources in every region of Québec. Its operations and actions have important repercussions on the environment.

Power-system operation requires the use of environmental contaminants as well as chemical controls for vegetation in remote areas. The noise emitted by some substations as well as the design and appearance of components in the overhead distribution system are characteristics associated with operating a power system. Reservoir management, control of water level variations and flows, and multi-purpose use of generating sites are matters of concern for other users of the land.

Several years ago, Hydro-Québec began to study the principal environmental problems associated with its operating activities. These steps allow the description and definition of problems, so that the criteria and actions needed to solve them can be determined.

The polychlorinated biphenyls (PCB) action plan adopted in 1986 led to measures to provide safe management and eliminate PCBs within a 10-year period. A first plan of action for improving existing facilities, carried out from 1986 to 1988, will be reviewed in 1988 for its environmental efficacy and socio-economic spinoffs. This plan of action attempts, through various types of activities, to apply to existing equipment the same environmental criteria as for new facilities.

The same analysis and planning approach will make it possible to determine the immediacy of problems and define environmental programs, whose timetables and mechanisms will vary in terms of the human, material and financial resources required. Included in the human resources aspect is increasing awareness and suitable training for those employees responsible for locating distribution facilities.

6.2 Orientations of the Power System Operation Plan

Analysis of the problems involved in power-system operation, combined with the study of Hydro-Québec's prospects and capacities in this area, have led the utility to adopt orientations in three areas that will guide its operations activities in coming years. These are:

- quality of customer service;
- maintenance efficiency;
- profitability of operation.

Human resources management plays a major role in the execution of these orientations. The utility must continually adapt some of its practices and regulations to better respond to the terms of collective agreements and laws as well as the work methods of its partners. Increased productivity remains the common concern of all, within the framework of this process.

6.3 *Objectives and Strategies*

OBJECTIVE 1

Improve the continuity and quality of the electricity supply.

STRATEGIES

1. Complete the service quality enhancement program.

   This five-year program, involving an investment of $1,003 million, began in 1984. It is designed to upgrade service quality by strengthening the reliability of the power system as a whole. A 10% decrease in planned service interruptions and power failures was achieved between 1984 and 1987. The results (medium voltage) are an estimate based on the initial data collected by the recently developed service quality evaluation system.

2. Continue the pilot project for the remote control of strategic disconnection points on the distribution system.

   This project, under way since 1986, is intended to measure the cost-effectiveness of generalizing such remote control systems and to define their functional characteristics.

3. Continue the installation of distribution control centres.

4. Study and ensure the implementation of new transmission design criteria to improve performance and reduce the risk of general power failures.

OBJECTIVE 2

Increase maintenance efficiency, taking into account the impact on the utility's revenue, the safety of employees and the public, operating requirements and technological developments.

STRATEGIES

1. Establish a long-term replacement program to deal with aging installations and environmental and safety regulations, in order to guarantee adequate long-term availability of facilities.

The upgrading of generating units at Shawinigan 2 and Bersimis 1 and 2 is progressing as planned, while studies are continuing on whether to modernize or replace the Les Cèdres, Chelsea, Rapides Farmers and Grand-Mère installations.

Upgrading is under way or planned for some 15 smaller-size stations on the St. Lawrence, Saint-Maurice and Gatineau rivers. With respect to the Daniel Johnson Dam at Manic 5, the utility has adopted the solution of permanent thermal reinforcement for the dam. Since it is now considered safe, Hydro-Québec will gradually raise the water level.

2. Improve the availability of existing facilities and reduce the costs of supplying electricity by a re-evaluation of:

- the design of generating facilities;;
- maintenance, modification, rebuilding and replacement practices;
- conditions under which the major maintenance program is executed;
- equipment management.

Initial efforts will focus on improving the availability of generating facilities.

3. Invest in research and development of automated tools (remote manipulation and robotics) to improve the quality of service and safety of employees and in the modernization of the software required to perform activities like planning, engineering and maintenance management.

4. In the area of safety, standardize the work methods of Hydro-Québec's employees and partners by:

- stipulating safety requirements in calls for tender;
- requiring contractors to manage their own workers;
- revising the work rules, especially those regarding de-energized lines (padlocking).

OBJECTIVE 3

Increase the profitability of power-system operation.

STRATEGIES

1. Make a systematic evaluation of new ways for increasing the generation and delivery of electricity:

- training of operators and back-up employees;
- energy resource management;
- allocation of available human and financial resources;
- use of higher performing equipment;
- consumption management;
- management of exchanges with neighboring systems.

At the same time, the utility will continue to carry out planned improvements.

2. Equip the regional control centres and the system control centre with automatic control devices and software that will optimize the distribution of the load among generating stations and generating units and improve exchange management.

3. Complete the installation of remote controls in all regional control centres.

4. Adjust and introduce modes for using various demand management methods for system control within the framework of existing marketing programs.

OBJECTIVE 4

Continue present efforts to ensure the protection and enhancement of the environment as part of operating activities.

STRATEGIES

1. Manage the environmental risks associated with activities involving PCBs and the improvement of existing equipment, and identify the hazards associated with the biological effects of electric and magnetic fields, contaminants and the use of herbicides for plant control.

2. Identify the problems associated with environmental protection and enhancement for the distribution system, reservoir management, equipment noise levels and multi-purpose use of Hydro-Québec property and installations.

6.4 *Supply and Demand Balance Sheet*

Hydro-Québec's supply must be adequate to satisfy contractual commitments on both Québec and external markets, while covering transmission losses that occur as part of these sales.

The utility's average energy supply, evaluated at 172.9 terawatt-hours per year in 1987, with the improvements made in generating facilities, will satisfy contractual commitments through 1994. Until then, existing installations can satisfy energy needs, in spite of variations in natural inflows from season to season and year to year. To reduce the effect of run-off variability, Hydro-Québec depends mainly on its reservoirs, purchases from neighboring systems, the recall provision under certain export sales contracts and Tracy thermal generating station.

At this time, Hydro-Québec's reserves are not at their maximum level, mainly because of the water level restrictions in recent years at Manic 5 and lower-than-average run–off in 1987.

By 1994, the utility will accumulate some of the run-off to increase the active storage in existing reservoirs, including the one at Manic 5, and thus be able to guarantee the growing needs for firm electricity with adequate reliability. Beyond this horizon, the reservoirs which are usually part of newly commissioned hydroelectric base-load facilities will maintain energy reliability at an adequate level.

TABLE 13
FIRM ELECTRICITY REQUIREMENTS
TARGET DEMAND SCENARIO

(in terawatthours)

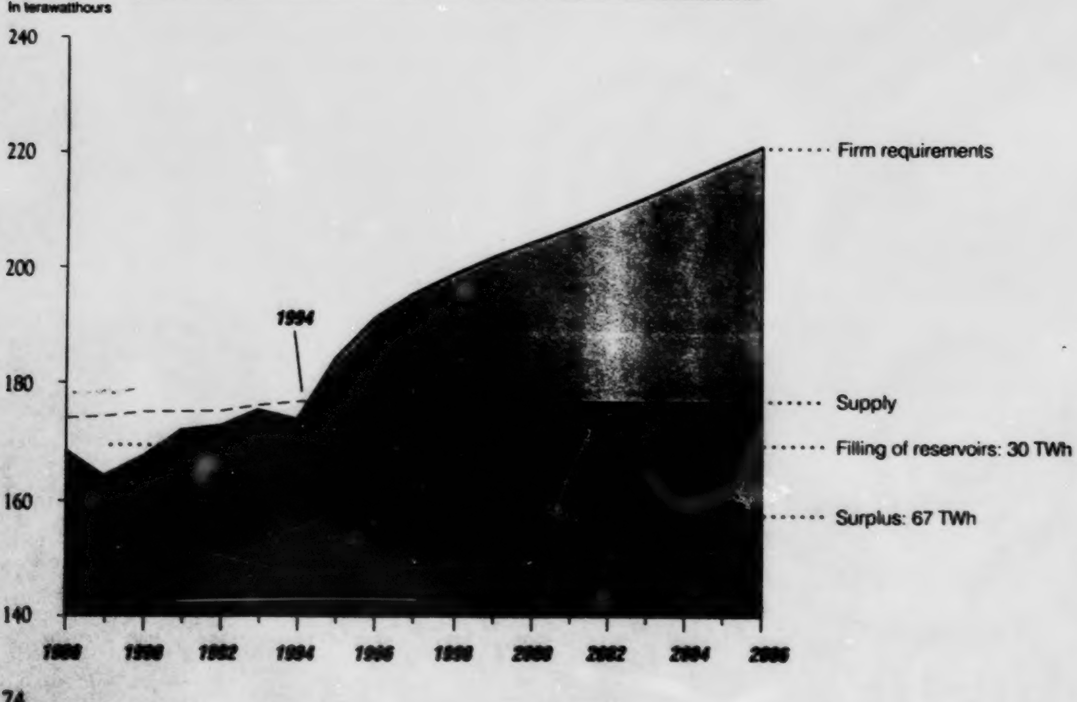
	1988	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***
Sales of firm electricity in Québec	115.9	120.5	125.1	129.0	132.1	136.0	139.6	144.7	147.7	151.3
Sales of surplus* electricity in Québec	11.4	2.2	0.4	-	-	-	-	-	-	-
Deliveries as per agreement in Québec	3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Export sales of firm electricity	8.0	8.3	10.3	14.9	16.4	16.5	14.5	19.1	22.8	22.8
Associated electrical losses	13.6	13.6	14.1	14.7	15.1	15.6	15.8	16.6	17.2	17.6
TOTAL	152.2	148.6	153.9	162.6	167.6	172.1	173.9	184.4	191.7	195.7

* Most of these sales are guaranteed, except for 1.5 terawatthours in 1989, and 0.4 terawatthours in 1990.

Accordingly, by 1994, Hydro-Québec will have energy surpluses totaling about 67 terawatthours. Because of the electrical losses associated with the transmission system, estimated at about 4 terawatthours, these surpluses will result in sales of about 63 terawatthours on the surplus electricity export markets.

The supply of power from existing facilities and their improvements, combined with the additional capacity at Manic 5 in 1989 and La Grande 2 in 1992-1993, is sufficient to meet needs until 1994, given the end of industrial boiler deliveries and the anticipated increase in interruptible-power loads. The utility does not need any new peak-load equipment before 1995.

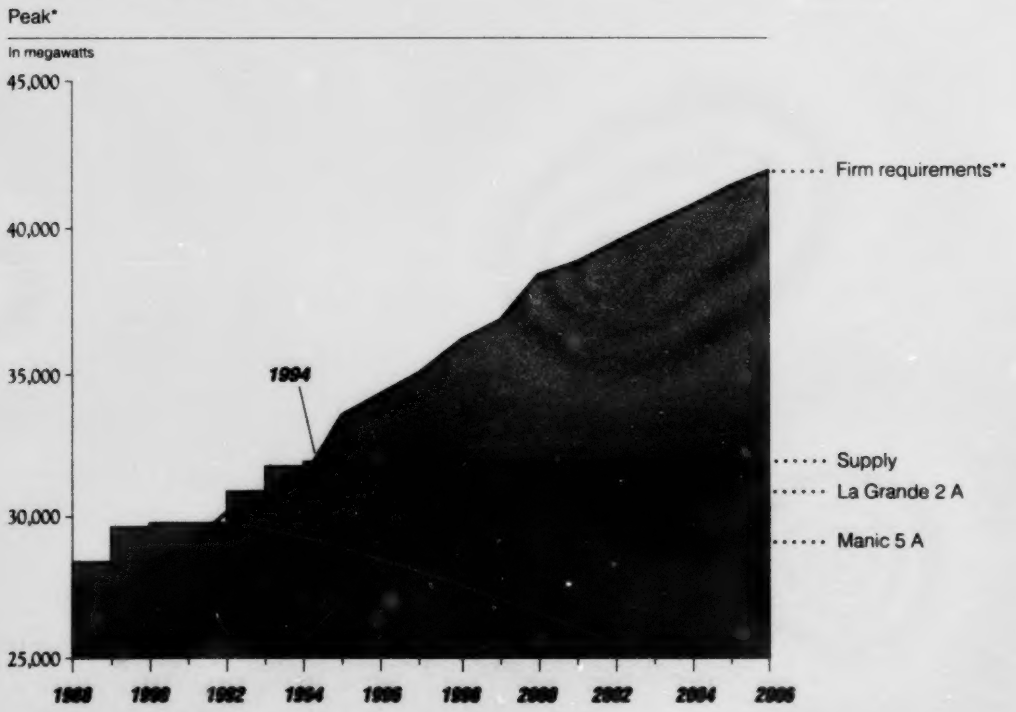
FIGURE 21
SUPPLY VERSUS TARGET ENERGY DEMAND



Until then, the generating facilities are in balance with demand, unlike recent years when there were power surpluses. They will be sufficient to satisfy variable demand, even when some generating facilities are occasionally unavailable. Available generating reserve will ensure adequate system reliability. In addition to reserve generating facilities, there are possibilities of power support from neighboring systems and interruptible industrial loads.

If unforeseen demand and unanticipated shortfalls in generating capacity should occur simultaneously, the utility could use these remedies to balance supply and demand as it did during the winter of 1987-1988.

FIGURE 22
SUPPLY VERSUS TARGET POWER DEMAND



* Winter beginning December of each year.
** Including required reserve.

7. POWER-SYSTEM DEVELOPMENT

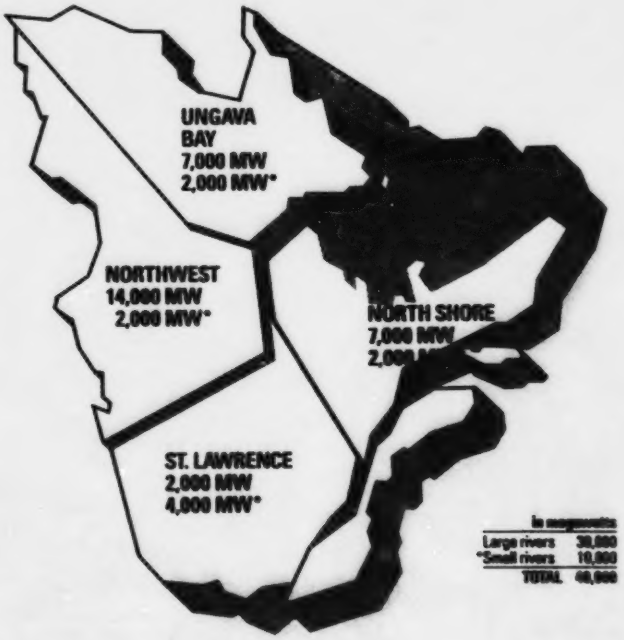
. . . .

The Hydro-Québec approach to power-system development is to plan electricity generating and transmission facilities in such a way as to satisfy contractual commitments while providing sufficient flexibility for rapid adjustment to market developments. This means meeting additional requirements for power and energy expected to emerge as early as 1995. To assure this future expansion, Hydro-Québec has substantial undeveloped hydroelectric potential.

7.1 Undeveloped Hydroelectric Potential

The map below indicates how the undeveloped hydroelectric potential is divided among the major regions of Québec.

MAP 4
QUÉBEC'S UNDEVELOPED HYDROELECTRIC POTENTIAL


UNGAVA BAY
7,000 MW
2,000 MW*
NORTHWEST
14,000 MW
2,000 MW*
NORTH SHORE
7,000 MW
2,00
ST. LAWRENCE
2,000 MW
4,000 MW*
In megawatts
Large rivers 30,000
*Small rivers 10,000
TOTAL 40,000

Large Rivers

Large undeveloped rivers represent potential annual energy production of 200 terawatthours. The corresponding installed capacity would depend on the annual delivery profile. For example, if this energy is generated at a utilization factor of 80%, it would provide 30,000 megawatts.

The potential of these large rivers is divided mainly among four regions of Québec: Northwest, North Shore, St. Lawrence region and Ungava.

The **Northwest** (James Bay and Hudson Bay) alone contains nearly half the potential from large rivers, some 14,000 megawatts. Large rivers on the **North Shore** offer a potential of about 7,000 megawatts. The **St. Lawrence** region, covering the territory south of James Bay and the North Shore, has a potential of more than 2,000 megawatts. The resources of the **Ungava** offer a potential of some 7,000 megawatts.

Studies now available indicate that a portion of this potential, some 95 terawatthours per year, corresponding to about 18,000 megawatts at an overall utilization factor of about 60%, is more economical than any alternative generating option (nuclear, oil- or coal-fired), even including transmission costs for bringing the electricity to load centres. The Northwest, which contains 90% of this economically viable potential, is the region offering the most attractive overall development prospects.

TABLE 14
ECONOMICALLY VIABLE HYDROELECTRIC POTENTIAL

Hydroelectric generating stations or complexes	***Maximum power at peak*** (in megawatts)	***Average annual output*** (in terawatthours)
La Grande 1	1,296	7.3
Laforge 1	783	4.5
Brisay	385	2.3
Sainte-Marguerite	822	4.2
Grande Baleine	2,891	15.1
Ashuapmushuan	550	3.2
Laforge 2	270	1.7
Eastmain 1	510	2.9
Nottaway-Broadback-Rupert (NBR)	8,700	45.0
La Romaine	1,710	8.9
TOTAL	17,917	95.1

Small Rivers

More than 400 small rivers, scattered throughout Québec, offer combined potential of 10,000 megawatts. Each of these rivers has a number of developable sites with a potential of under 100 megawatts and, in some cases, as little as 1 or 2 megawatts.

Hydro-Québec is now studying the possibility of developing some of these rivers for its unconnected power systems, where this output could advantageously replace generation from thermal sources.

Small generating stations can also be developed and operated by independent producers. In 1987, the utility adopted a policy for purchasing electricity from hydroelectric facilities of 25 megawatts or less or from any other generating facility using a resource other than water. This policy states that the purchase price of this electricity should be equivalent to the costs of generation, transmission and distribution saved by Hydro-Québec for the duration of the contract.

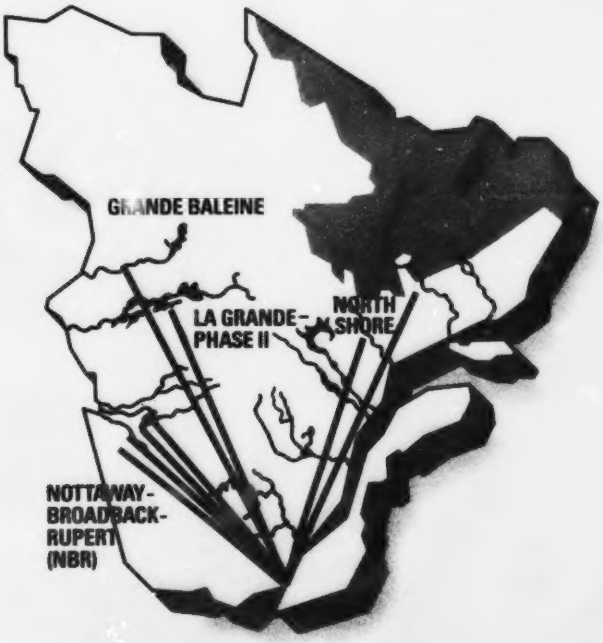
Complementary Facilities

Complementary facilities are needed to adapt production to peak demand for electricity in Québec. It is more economical to build additional capacity at existing hydroelectric generating stations than to add peak-load thermal facilities. This is the reason for the additional capacity now being installed at Manic 5 and La Grande 2. Similar projects may be carried out in generating stations on the Manicouagan, Bersimis, Outardes and Saint-Maurice rivers.

For electricity transmission over the long distances to load centres, 735 kilovolt alternating current lines remain the most appropriate choice, given the configuration of the Québec power grid. They are also most economical and are technically proven.

MAP 5

TRANSMISSION SYSTEM FOR INTEGRATING ECONOMICALLY VIABLE HYDROELECTRIC POTENTIAL



To integrate all 18,000 megawatts of most economically viable potential, eight new 735 kilovolt transmission lines would probably be needed, six from the Northwest region and two for output from the North Shore. Transmission system requirements are dealt with in greater detail in a separate publication entitled *Hydro-Québec's Future Generating and Transmission System*.

7.2 The Target Construction Program

7.2.1. Commissioning Dates

Projects in Progress

Projects to add capacity to Manic 5 and La Grande 2 generating stations are in progress, with commissioning planned for 1989 and 1992-1993, respectively. Commissioning of the direct current line of the James Bay transmission system, the 11th line of the Hydro-Québec transmission system, is planned for 1990.

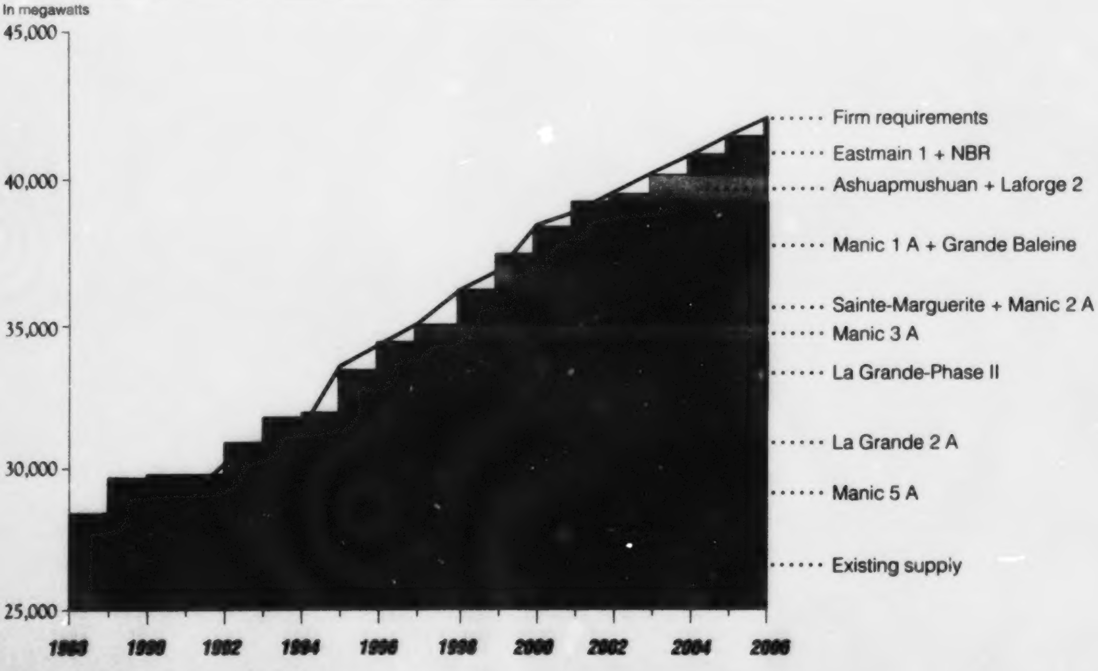
Hydro-Québec will commission the Radisson and Nicolet converter substations in 1990 and 1992, respectively.

Future Projects

Considering existing facilities, improvements to them and projects in progress, additional power and energy needs begin to appear in 1995.

FIGURE 23
TARGET CONSTRUCTION PROGRAM

Peak*

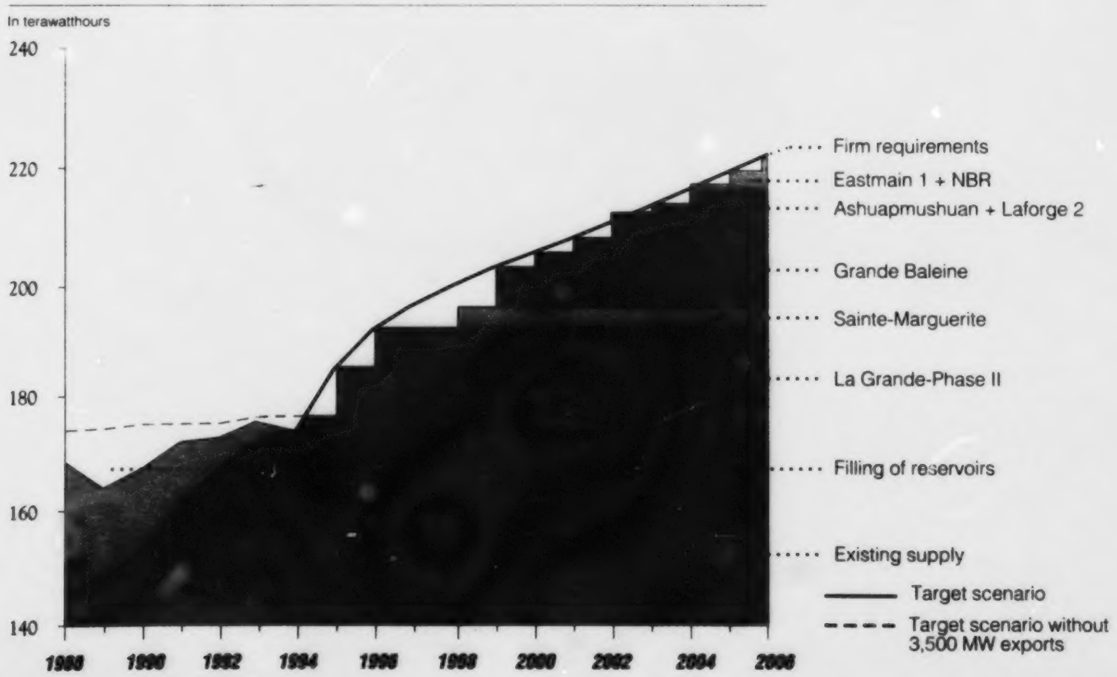


* Winter beginning December of each year.

The earlier scheduling for construction of base-load facilities for export sales of firm power and energy of 3,500 megawatts is shown here.

The target construction program calls for the development of nearly 10,000 megawatts of generating facilities between now and 2006 in addition to the projects in progress. According to this program, 16 new generating stations will be commissioned, along with four new 735 kilovolt alternating current transmission lines.

FIGURE 24
EARLIER CONSTRUCTION SCHEDULE FOR EXPORTS OF 3,500 MW



To meet additional requirements for power and energy as of 1995, it would be most economical to build Phase II of the La Grande Complex. La Grande 1 and Brisay would therefore be commissioned in 1995 and 1996, respectively, as indicated in the target scenario of last year's plan. But commissioning of Laforge 1 would have to be moved forward from 1997 to 1995 in light of the latest hypotheses, notably increased demand. The 1995 date would have to be maintained for the 12th 735 kilovolt alternating current line.

As of 1995, a 13th 735 kilovolt alternating current line will be commissioned to carry the additional power of new turbine runners in the Manic 5 and Manic 3 generating stations and additional capacity at Manic 3, 2 and 1 from the Manicouagan complex to load centres. This line will be extended from the Manicouagan complex to Sainte-Marguerite generating station, commissioned in 1998.

The first commissionings at the Grande Baleine complex are scheduled for 1999. A 14th transmission line would then be needed from there to load centres.

The two generating stations on the Ashuapmushuan River, which will be commissioned in 2002 and 2003, and the Laforge 2 generating facility in 2003 will not require the construction of an additional 735 kilovolt transmission line. Their smaller size will allow them to be absorbed into the transmission system as it then exists.

A 15th 735 kilovolt transmission line is planned in the 2004 horizon with the first commissionings of the Nottaway-Broadback-Rupert complex and Eastmain 1 generating station.

Investments in generation and transmission, including rebuilding work, are evaluated at nearly $28 billion for the 1988-1997 period.

MAP 6

ADDITIONAL TRANSMISSION LINES FOR THE TARGET CONSTRUCTION PROGRAM HORIZON 2006

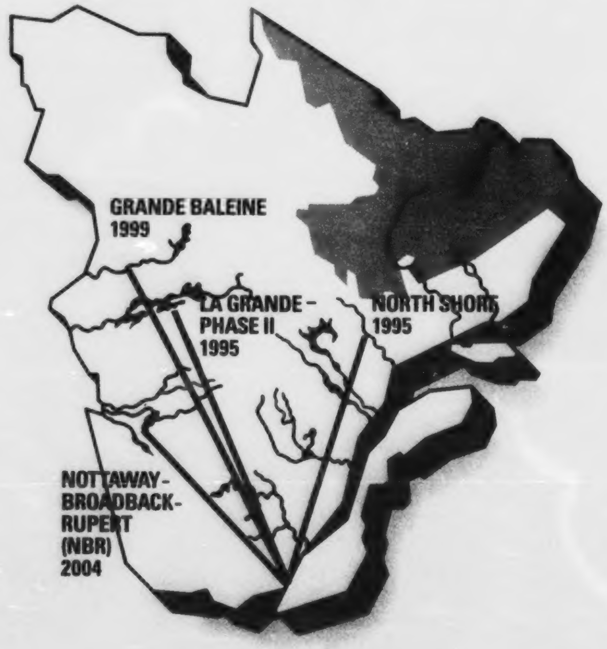


TABLE 15
COMMISSIONING DATES FOR THE TARGET CONSTRUCTION PROGRAM

	Maximum power at peak (in megawatts)	***Commissioning***
Major projects in progress		
• Manic 5 A	1056	1989
• La Grande 2 A	1900	1992-1993
• 11th line 450 kV DC Radisson - Nicolet - Des Cantons		1990
Future projects		
La Grande - Phase II		
• La Grande 1	1296	1995-1996
• Laforge 1	783	1995
• Brisay	385	1996
• 12th line 735 kV AC		1995
North Shore		
• Manic 5 and 3 turbine runners	248	1995
• Additional capacity for Manic 3, 2 and 1	1042	1997-2000
• Sainte-Marguerite	822	1998
• 13th line 735 kV AC		1995-1998
Grande Baleine Complex		
• Grande Baleine 1, 2 and 3	2891	1999-2001
• 14th line 735 kV AC		1999
Ashuapmushuan Complex	550	2002-2003
Northwest		
• Laforge 2	270	2003
• Eastmain 1	510	2004
• NBR Complex	8700	2004-...
• 15th line 735 kV AC		2004
Other peak-load plant	372	2005

TABLE 16
INVESTMENTS IN MAJOR PROJECTS IN PROGRESS

(in millions of current dollars)

Projects	At December 31 1987	1988	1989	1990	1991-1997	TOTAL
Generation						
• Manic 5 A	576	150	88	3	-	817
• La Grande 2 A	98	126	219	287	613	1,343
Transmission						
• 450 kV DC line and Radisson and Nicolet substations	349	500	383	209	91	1,532

7.2.2 The Decision Timetable

Advanced studies of the first planned base-load facilities are complete, and the utility can begin these projects very soon after governmental approval is received. Studies for the La Grande 1, Laforge 1 and Brisay generating stations are also complete, and governmental approvals should be obtained starting in 1988 for decisions, as of 1988, if needed, on these projects. Furthermore, Hydro-Québec is starting studies of the 12th alternating current line, so as to be ready when the first units of La Grande 1 generating station are commissioned.

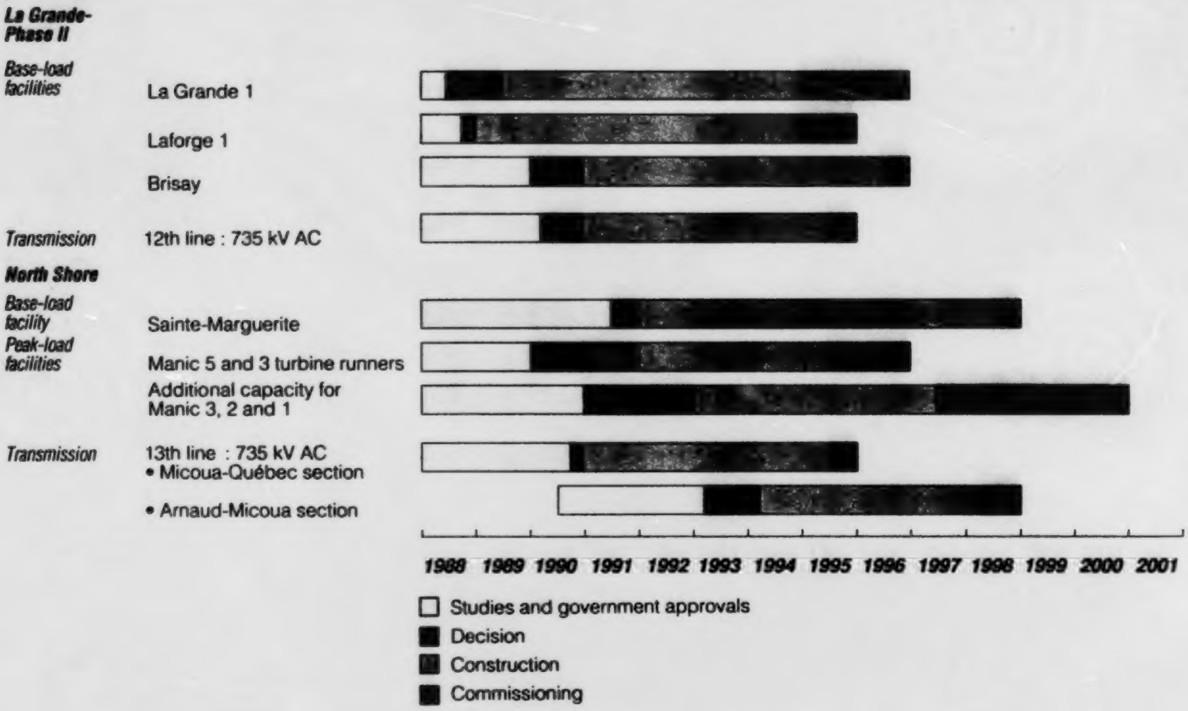
The utility will continue studies in 1988 on additional capacity at the Manicouagan complex, to be able to start commissioning these facilities in 1995.

Preliminary project studies on Sainte-Marguerite will be continued in order to meet the planned 1998 commissioning date.

Studies on the 13th alternating current line on the North Shore began in 1987, to enable transmission of additional capacity from the Manicouagan complex as of 1995.

The construction schedule and budget of the Grande Baleine Complex will be updated in 1988 to allow optimal integration in the power-system development program.

FIGURE 25
DECISION TIMETABLE - TARGET SCENARIO



7.2.3 *Electrical Energy Balance Sheet*

A comparison of Hydro-Québec's total deliveries with the energy resources it expects to have available, including those from commissioning new generating facilities, makes it possible to identify the configuration of energy supply that will most reliably meet the utility's contractual commitments while maximizing opportunities available on the Québec and export surplus energy markets.

Supply includes hydroelectric and thermal generation as well as electricity received, principally from Churchill Falls.

TABLE 17
ELECTRICAL ENERGY BALANCE SHEET*

(in terawatthours)

	1986	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
Supply												
Hydroelectric generation												
• Run-off	132.0	123.2	134.2	134.3	134.3	134.3	134.5	135.8	136.1	141.3	148.1	150.4
• Variation (drawdown + accumulation -)	-4.8	11.3	-5.3	-10.1	-7.2	-2.3	-1.2	-0.6	-3.0	2.5	2.6	4.4
• Spilling	-3.4	-2.0	-	-	-	-	-	-	-	-	-	-
Total	123.8	132.5	128.9	124.2	127.1	132.0	133.3	135.2	133.1	143.8	150.7	154.8
Thermal generation	4.3	5.2	5.6	5.0	5.5	5.5	4.8	4.8	4.8	4.8	5.1	5.0
Electricity received	32.8	32.6	34.4	35.1	35.2	35.2	35.3	36.2	36.1	35.9	35.9	35.9
Generation and electricity received	160.9	170.3	168.9	164.3	167.8	172.7	173.4	176.2	174.0	184.5	191.7	195.7
Electrical losses and other	-13.6	-14.3	-14.4	-14.4	-14.8	-15.2	-15.4	-15.8	-15.8	-16.6	-17.2	-17.6
Total deliveries	147.3	156.0	154.5	149.9	153.0	157.4	157.9	160.5	158.1	167.9	174.5	178.1
Demand												
Sales in Québec												
• Firm	103.5	110.4	115.9	120.5	125.1	129.0	132.1	136.0	139.6	144.7	147.7	151.3
• Surplus	13.7	13.7	11.4	2.2	0.4	-	-	-	-	-	-	-
Total	117.2	124.2	127.3	122.8	125.5	129.0	132.1	136.0	139.6	144.7	147.7	151.3
Export Sales												
• Firm	7.0	8.3	8.0	8.3	10.3	14.9	16.4	16.5	14.5	19.1	22.8	22.8
• Surplus	19.9	20.5	16.0	14.8	13.2	9.6	5.5	4.0	-	-	-	-
Total	26.9	28.8	23.9	23.1	23.5	24.5	21.9	20.5	14.5	19.1	22.8	22.8
Total sales	144.1	152.9	151.2	145.9	149.0	153.4	153.9	156.5	154.1	163.9	170.5	174.1
Deliveries as per agreement	3.2	3.1	3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Total deliveries	147.3	156.0	154.5	149.9	153.0	157.4	157.9	160.5	158.1	167.9	174.5	178.1

* The figures in this table are rounded off. As a result, when added, they may differ from the total shown.

7.3 The Construction Program According to Various Québec Demand Scenarios

The construction program as it now stands was designed to offer the necessary flexibility to deal with changes in energy needs. Projects can be accelerated or delayed, depending on the economic situation, or adapted to make better use of the territory. Two scenarios have been used to measure the impact of any growth in firm sales in Québec that differs from the forecast. The high demand scenario anticipates 3.3% growth from 1986-2006 and the low demand scenario 1.9%. These two scenarios, like the target scenario, take into account the Québec dual-energy and interruptible-load marketing programs and the 3,500-megawatt objective on external markets.

TABLE 18
CONSTRUCTION PROGRAM ACCORDING TO VARIOUS QUÉBEC DEMAND SCENARIOS

	Demand scenario		
	Target	***Strong***	***Weak***
Growth of sales of firm electricity in Québec (1986-2006)	***2.7%***	***3.3%***	***1.9%***
Additional exports to horizon 2001	***3,500 MW***	***3,500 MW***	***3,500 MW***
Project in progress			
• Manic 5 A	1989	1989	1989
• La Grande 2 A	1992-1993	1992-1993	1992-1993
• 11th line 450 kV DC Radisson - Nicolet - Des Cantons	1990	1990	1990
Future projects			
La Grande - Phase II			
• La Grande 1	1995-1996	1994-1995	2000-2001
• Laforge 1	1995	1995	2004
• Brisay	1996	1995	2004
• 12th line 735 kV AC	1995	1994	2000
North Shore			
• Manic 5 and 3 turbine runners	1995	1995	1996
• Manic 3, 2 and 1 additional capacity	1997-2000	1995-2008	1998-2000
• Sainte-Marguerite	1998	1998	*
• 13th line 735 kV AC	1995-1998	1995-1998	1996-...
Grande Baleine Complex			
• Grande Baleine 1, 2 and 3	1999-2001	1997-1998	*
• 14th line 735 kV AC	1999	1997	*
Ashuapmushuan Complex	2002-2003	1998	*
Northwest			
• Laforge 2	2003	1996	*
• Eastmain 1	2004	1996	*
• Nottaway-Broadback-Rupert	2004-...	1997-...	*
• 15th line 735 kV AC	2004	1998	*

* Commissioning after 2006.

If the high growth scenario materializes, the commissioning of all base-load facilities planned in the target scenario would occur earlier. Future peak-load installations would also have to be built sooner.

If the low growth scenario materializes, La Grande 1 would be postponed from 1995 to 2000 and Laforge 1 and Brisay from 1995 and 1996 to 2004. Sainte-Marguerite, Laforge 2, Grande Baleine, Ashuapmushuan, Eastmain 1 and Nottaway-Broadback-Rupert would be postponed beyond the 2006 horizon.

Investments in generating and transmission for the high and low growth scenarios for firm electricity in Québec for the 1988-1997 period are $52 billion and $15 billion respectively, compared to $28 billion in the target scenario.

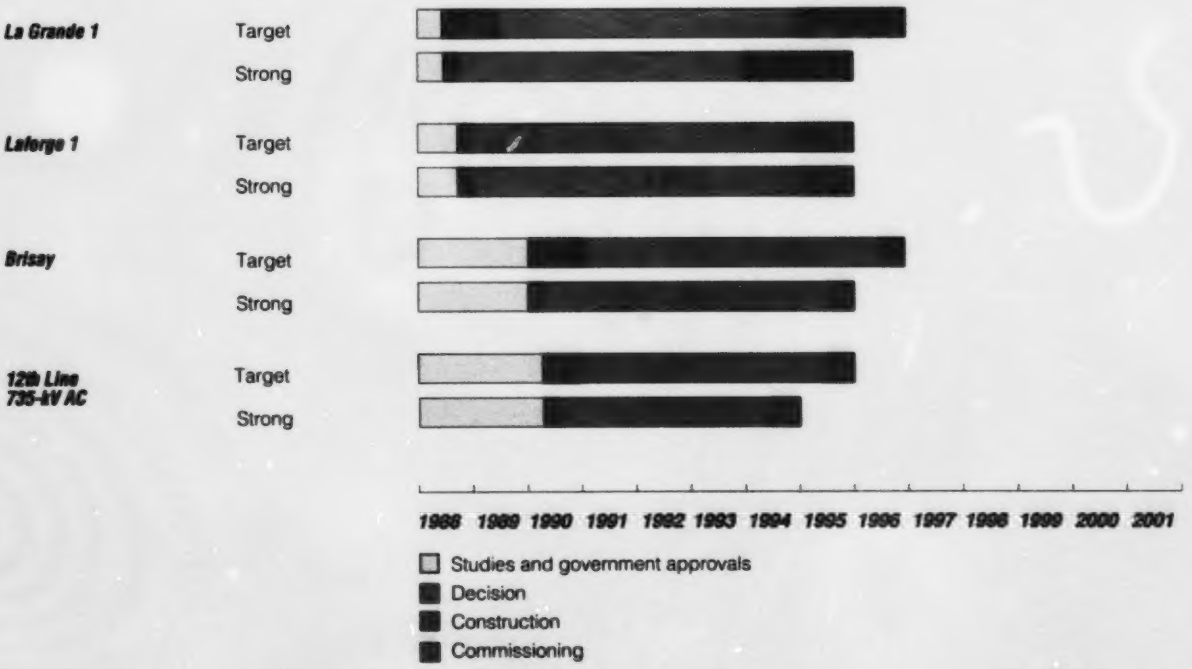
7.4 Generating Flexibility

The utility must have the flexibility to react quickly to changes in the markets.

Should there be strong growth in Québec demand for electricity, the utility could, if necessary, commission La Grande 1 in 1994-1995, one year earlier than in the target scenario. This would only be possible if government approval for the La Grande 1 generating station is obtained in 1988.

The Laforge 1 project would remain at its earliest commissioning date of 1995, because in 1987 the utility completed the studies required for this early commissioning date.

FIGURE 26
DECISION TIMETABLE - LA GRANDE 1 / LAFORGE 1 / BRISAY



7.5 Environmental Impacts and Planning

Three main strategies are used by the utility to see that the target construction program is executed in a way that optimizes the interaction of the projects with their environment. These strategies involve integrating environmental concerns in project planning as early as possible.

Modifications in the construction procedures for generating and transmission facilities were introduced in 1987. Preliminary project studies now take place in two distinct phases. For generating equipment, these consist of choosing one development alternative and then optimizing the alternative selected. For transmission facilities, the first phase consists in selecting a corridor and the second in defining and optimizing the route within the selected corridor. This should allow broader consultation with the land–use planners and developers and the public in both phases, as well as facilitating the inclusion of their concerns and improving overall project acceptability. To achieve this, the preliminary and draft-design studies required by the construction program are begun earlier, to give the utility sufficient time for the appropriate consultations. Moreover, employees responsible for building and operating generating, transmission and sub-transmission equipment are being made more aware of and better trained in the needs of the environment.

Additionally, environmental follow-up programs introduced in recent years will be continued. These post-construction programs are designed to evaluate the actual impacts of new facilities. Knowledge acquired from environmental follow-up will allow future impact studies to concentrate on significant environmental problems and reach agreement on appropriate mitigative measures with the government departments and agencies concerned.

Likewise, since 1987, the utility has sought to identify the cumulative effects of the construction program on the environment. This initiative aims to establish the overall environmental effects of all facilities included in the construction program. It is an experimental effort to make a prospective analysis of the environmental consequences of the target scenario. Given the utility's extensive experience, this approach should enable it to anticipate overall impacts, and, after additional research and studies, identify solutions for resource utilization and improvements in planning, design, construction and operating practices.

7.6 *Objectives and Strategies*

OBJECTIVE 1

Plan Hydro-Québec's generating facilities and transmission system to both satisfy contractual commitments and provide the flexibility needed to adjust rapidly to the market, while making rational use of water resources.

STRATEGIES

1. Complete activities necessary for commissioning of **additional capacity at Manic 5** in 1989.

2. Complete activities necessary for commissioning **additional capacity at La Grande 2** in 1992-1993.

   Also commission Radisson rectifier station and the 450 kilovolt direct current line in 1990 and Nicolet inverter station in 1992.

3. Prepare decisions on generating and transmission equipment to implement development strategies for Québec and external markets. To do this:

a) starting in 1988, obtain all government approvals for the execution of **Phase II of the La Grande Complex**, which includes La Grande 1, Laforge 1 and Brisay, and continue studies on the 12th line of the transmission system (6th James Bay line);

b) in 1988, update the construction schedule and estimate for the **Grande Baleine** complex, to define its optimal inclusion in the construction plan;

c) continue studies on the **Sainte-Marguerite** project, so that it can be commissioned in 1998;

d) in 1988, update the studies for the **Laforge 2** and **Eastmain 1** projects, to determine how they can be economically included in the construction program;

e) in 1988, continue studies for optimizing management of the Saint-Maurice River by developing additional generating facilities or rebuilding existing facilities;

f) conduct studies to make the **Nottaway-Broadback-Rupert** complex compatible with the development of Québec and external markets, and determine the pace of development that will maintain the economic advantages of the complex;

g) in 1988, pursue studies on turbine **runner modifications at Manic 5 and 3** and on additional capacity at Manic 3, 2 and 1, in order to have sufficient peak-load facilities by 1995 if needed;

h) also continue studies of an **alternating current line to the North Shore**, to carry the additional output from the Manicouagan complex.

OBJECTIVE 1

STRATEGIES

4. Make a decision in 1988 for the commissioning of the first Magdalen Islands supply cable in 1991 and the second one in 1992.

5. Continue feasibility studies for a mini-hydroelectric generating station at Povungnituk to supply needs in the far north.

6. Continue studies on upgrading diesel generating facilities at Blanc Sablon and La Tabatière on the Lower North Shore, in case Robertson hydroelectric generating station is postponed.

OBJECTIVE 2

Promote the increased use of environmental data at the planning, design and construction stages of generating and transmission facility projects.

STRATEGIES

1. Subdivide the projects into two phases and bring the studies schedule forward, so that land–use planners and developers and the public can be better consulted and their views integrated in the results.

2. Use the results of environmental follow-up to concentrate future impact studies on significant environmental impacts and reach agreements with government departments and agencies on relevant mitigative measures.

3. Identify problems arising from the cumulative effects on the environment of the construction program, and establish more detailed research and development priorities in light of anticipated problems.

8. TECHNOLOGY AND INTERNATIONAL AFFAIRS

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8.1 Technology

8.1.1 Issues and Orientations

Technology is strategic for Hydro-Québec. Most of the utility's fields of activity contain major technological challenges.

With its responsibilities for the development and use of Québec's hydroelectric resources, Hydro-Québec must constantly seek to increase the efficiency of its existing installations and optimize new plant. Before the end of the next decade, replacement, modernization and additions of new facilities will require even greater technological development.

Expansion of the transmission system to satisfy Québec needs and energy exports will reach a decisive stage in which the technical fundamentals characteristic of a vast system must all be perfected. The new interconnections and expanded exchanges between Hydro-Québec and neighboring systems pose particular reliability and stability problems. The contribution of technology will therefore be extremely important for this sensitive sector.

Hydro-Québec must assure quality service for its customers and develop safe working methods and practices for employees and outside contractors. Recent technological progress and current research will make important contributions to improved understanding of the environmental impacts of present and future facilities and assist in defining the corrections needed to mitigate these impacts. Moreover, new technological products should help maintain and improve the quality of life of Québec society and the quality of the environment.

By making efficient use of electricity, electrotechnologies can be advantageous in industrial processes for both manufacturers and the utility. Demonstration and promotion of new equipment and processes help increase the penetration of electricity, retain existing markets and provide growth for Hydro-Québec.

New technological products also enable Hydro-Québec to contribute to Québec's economic development by creating or participating in leading-edge industries.

The large pool of human resources, especially those who exercise technical responsibilities on a daily basis, are a source of innovation for the utility. It is important to provide an auspicious climate for the development of this potential.

Technological advances, whether achieved by internal or external research services, are therefore essential for satisfying Hydro-Québec's short – medium – and long–term technical needs and for the economic well-being of Québec.

ORIENTATIONS

- Help reduce the costs of supplying electricity related to plant construction, system operation and customer service.
- Help solve technological problems related to exporting electricity and exchanging energy with interconnected systems.
- Contribute to improved quality of service, occupational health and safety and environmental quality.
- Support sales of electricity by developing and promoting electrotechnologies.
- Promote marketing of technology and expertise.
- Promote employee innovation and participation.

8.1.2 Current Status

The utility's size and the specific nature of its installations require it to innovate in a number of technological fields. These efforts require a complex organization, in which operational groups and centralized research, development, demonstration and testing services must collaborate. In 1987, to improve the R&D operating framework, the utility completed a reorganization of the Technology, International Affairs and IREQ group and instituted new planning and management mechanisms.

In the fall of 1987, a collaborative technology planning process was implemented. To support this effort, a steering committee and consultative groups were set up consisting of managers and technology specialists. This approach assures input from all administrative units in making the strategic choices that ensure the achievement of the utility's major objectives.

Also in 1987, Hydro-Québec began to introduce an in-house customer-supplier type relationship. As applied, each internal "customer" finances R&D projects the way that outside customers do. This approach increases the responsibility of all parties and leads to more useful results.

Furthermore, the utility has adopted a flexible system for managing technological innovation projects. Task forces operate on the basis of specific terms of reference, schedules and budgets negotiated when the project is launched and subject to review at regular intervals.

Some major programs have already triggered substantial R&D activities, for example, the 11th direct current line and its underwater crossing.

Other R&D contributions include the management of hydroelectric reservoirs and the analysis of systems, facilitated by continued improvements in software and the development of expert systems. R&D in robotics has demonstrated the feasibility of robot repairs of turbines. IRECA stainless steel, developed at Hydro-Québec, has proved to be economical for repairing cavitation damage to turbines. In addition to being adopted for use at Hydro-Québec, IRECA steel is now being marketed under license. The development of a dosimeter will assist in investigating the environmental risks associated with the biological effects of electric and magnetic fields. This study is part of a general $7 million research program on field effects.

The electrochemistry and electrotechnology laboratory (LTEE), in operation since July 1987, is an indispensable Hydro-Québec tool for the development and demonstration of new electrical processes. Some 10 industrial projects are now under way there, and $1.5 million in financial assistance, mostly from the Canada-Québec technical cooperation agreement, has been paid to LTEE. Its R&D program, as defined in 1987, involves a budget of some $30 million between now and 1990.

Recent international discoveries in the field of superconductivity were the subject of special investigation in 1987. New findings, although still in the laboratory phase, could rapidly result in technical changes and major financial benefits.

The new Canadian Magnetic Fusion Centre is now integrating all scientific activities involving nuclear fusion. Its three founders, Hydro-Québec, Atomic Energy of Canada Limited and the Institut national de la recherche scientifique, are pooling financial and scientific contributions to assure the centre's success.

Hydro-Québec has continued to explore various paths that may lead to mastery of the production of hydrogen at lower cost. As part of a project for developing electric vehicles, Hydro-Québec is studying the possibility of using polymer electrolyte batteries which allow better energy storage and substantial reductions in battery weight.

In addition to exercising technological leadership in these areas, Hydro-Québec has also collaborated in various ways in the R&D activities of Québec universities and other agencies.

SOME COLLABORATIVE PROJECTS INVOLVING HYDRO-QUÉBEC AND QUÉBEC UNIVERSITIES

- Magnetic fusion: INRS and Université de Montréal
- Microwave laboratory: École polytechnique de Montréal
- Research on artificial lighting in greenhouses: Université Laval
- Chair of Environmental Studies: Université du Québec à Montréal

These technological development activities should require a total of $300 million from 1988 to 1990.

TABLE 19
RESEARCH AND DEVELOPMENT SPENDING AND SOURCES OF FUNDING IN 1987*

Breakdown of spending by type of activity	
• Research and development	43%
• Demonstration	29%
• Tests and simulations	28%
Breakdown of sources of funding	
• Centralized R & D services	62%
• R & D services of operational groups	22%
• Revenue (joint projects, laboratories, etc.)	16%

* Approximately $100 million allocated to R & D in 1987.

8.1.3 Objectives and Strategies

OBJECTIVE 1

Give priority in orienting technological activities to achieving the utility's major objectives.

STRATEGIES

1. Promote greater participation of those concerned in the orientation and follow-up of R&D programs and intensify internal use of R&D products.

The execution of this strategy entails actions and mechanisms that will affect both the method of participation and the definition of R&D projects.

1.1 Introduce new consultation mechanisms and management structures.

The new technology planning process will motivate various groups in the utility to adopt the corporate plan and develop programs and budgets in their own specific areas of expertise. The utility will also define and implement other incentives to increase internal technology transfers, the use of results and the participation of employees. These include:

- a new process for promoting technological innovation;
- a customer-supplier relationship;
- a structure for collecting technical suggestions from employees.

1.2 Intensify those R&D efforts most likely to be of significance for making strategic technological choices.

Generation

The utility will consolidate and develop expertise and tools to reduce uncertainty, starting at the design phase of development projects. Exploiting its current strengths, the utility will institute a program combining research and studies on water flows and the integrity and safety of dams and associated facilities.
Technological maintenance and monitoring needs will become increasingly numerous and diversified. Some of these are automatic controls for operations and robots for maintenance.
The utility will also expand its involvement in reservoir management and winter operation of hydroelectric facilities. In seeking attractive solutions to the problem of supplying electricity on unconnected systems, the utility will continue work on integrated small-power facilities and combined energy sources.

OBJECTIVE 1

STRATEGIES

Transmission

R&D efforts will be stepped up in the area of system behavior, notably on the implementation of new reliability criteria and commissioning of new interconnections. A multi-terminal power-system simulation laboratory, costing a total of $6 million, will be operational in late 1988.
Hydro-Québec will also improve its study methods of the mechanical, electrical and chemical reliability of cables. A new testing facility, costing $7 million, will be completed in 1989. The objective will be to apply any new findings to the design and operation of underground and underwater cables.

Distribution

The on-going goal of improving the quality and continuity of customer service is an incentive to gain greater knowledge of the status of existing equipment and to develop new devices that would reduce the number of failures and interruptions, especially on the underground circuits. The utility will also consolidate its efforts to develop appropriate automatic controls and forms of communication.
R&D work will give greater knowledge of the dynamic characteristics of the distribution system, including analysis and diagnostic methods and impacts on customers and facilities.
The utility will also expand its expertise in ergonomics and robotics, in order to assure a maximum level of security for the public and employees.

Energy Use

The application in industrial processes of various electrotechnologies such as infrared, induction heating and plasmas, seeks to develop internal markets by offering the efficient use of electricity. Efforts will be concentrated on electrical technologies that are best adapted to current and future needs and most appropriate for the development orientations of Québec's industrial markets.

2. Coordinate and harmonize technological prospecting and exploration efforts and information pertaining to the external supply.

This type of activity seeks to better define and disseminate knowledge in order to profit from efforts deployed elsewhere. Superconductivity is one example. The utility will continue prospecting to keep abreast of outside developments in key fields such as expert systems, advanced ceramics, conducting polymers, amorphous metals and artificial vision.

As in recent years, exploratory research will concentrate on nuclear fusion, hydrogen, polymer–electrolyte batteries and superconductors.

3. Intensify development and demonstration activities for new processes that use electricity.

Together with its industrial, government and university partners, Hydro-Québec will continue its strategy of developing R&D activities at LTEE. Moreover, certain projects of strategic interest, such as heat pumps with non-electric back-up, will also be pursued at LTEE.

OBJECTIVE 2

Market technological development activities and exploit opportunities for diversification.

STRATEGIES

1. Place greater emphasis on marketing aspects when selecting projects and technical solutions and develop products that meet Hydro-Québec needs and are competitive in the marketplace.

   Two projects illustrate the implementation of this strategy. In 1987, after having solved the main R&D problems associated with polymer–electrolyte batteries, Hydro-Québec took steps to find an industrial partner to build a pilot plant to make such batteries for the microelectronics market. The second innovative project, a distribution control centre using personal computers, is now under way in the Saint-Laurent region. Results obtained so far are positive and suggest that it may well be suited for the US market.

2. Market know-how and laboratory services while retaining priority for Hydro-Québec's needs.

   The utility intends to continue internal and external marketing efforts to maximize the use of its laboratories, sale of its expertise and participation in research programs sponsored by the government and private agencies. However, priority will be given to the needs of Hydro-Québec.

3. Carry out industrial activities in fields associated with or related to energy-based technologies developed and used by Hydro-Québec.

   In seeking association with partners, Hydro-Québec will promote the emergence and development of high–tech firms that appeal to international markets. Hence the decision to concentrate the activity of its Nouveler Inc. subsidiary in marketing technologies developed by the utility and its partners.

   Cyme International (a Hydro-Québec affiliate) is continuing to market new products based on expertise acquired in system analysis and the use of microcomputers. While these products are aimed at North American and European markets, they offer interesting possibilities in developing countries. The Vibrometer Inc. subsidiary, specializing in an air gap measurement system and instruments for measuring vibrations in rotating machinery, will complete its orientation studies and prepare a new plan of action. Hydro-Québec will also pursue its strategy of associating with partners and expanding efforts to market in-house software, distribution control centres and polymer–electrolyte batteries.

8.2 *International Affairs*

Hydro-Québec International (HQI) is responsible for marketing the utility's expertise abroad. Revenue in 1987 from these activities was more than $12 million, and to this must be added the spinoff effect of the continuous export of electricity-related goods and services and the opportunities for professional diversification among employees while ensuring the wider international reputation of Hydro-Québec.

OBJECTIVE 3

Increase the international presence of Hydro-Québec and its partners in financially accessible markets by marketing the expertise in electric-utility technology and management for which it is renowned.

STRATEGIES

1. Promote and publicize the exportable services for which Hydro-Québec has a comparative advantage.

Such services are those specific to the electric utility, such as distribution, customer service and power-system planning, operation and maintenance. Specific technologies, including those related to system control, live-line work and interconnections, are also areas in which Hydro-Québec has a competitive edge.

Greater efforts will therefore be deployed to adapt these products to the requirements of the various markets and develop sales tools to publicize them.

2. Intensify sales efforts in the most promising markets, where project financing is most certain.

Africa offers the most favorable opportunities and therefore should be the priority market. This strategy is in line with the goals of the Government of Québec, which has special energy responsibilities in the French-speaking community.

Asia, HQI's second most important market, offers more potential than China alone. In addition to consolidating our presence, marketing efforts will be continued there.

In view of regional interest in North American technology, the Middle East may again become an attractive market. Marketing efforts will also be deployed here.

Latin America is a more difficult market. Marketing programs will concentrate on maintaining contacts and seizing opportunities that may arise.

OBJECTIVE 3

STRATEGIES

3. Systematically seek out associations with private partners.

HQI favors international projects with private partners. This maximizes the economic spinoffs of projects and promotes the export of goods and services.

Projects leading to the construction of such facilities as dams, generating stations, lines and substations are generally carried out in conjunction with private consulting firms, while power-system operation is generally the responsibility of Hydro-Québec employees.

9. HUMAN RESOURCES MANAGEMENT

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9.1 *A Context of Consolidation*

Hydro-Québec has taken vigorous steps in the 1980s to ensure its financial soundness and support its development. Capital investment has been reduced, revenue increased and operating expenditure steadied. For human resources, the rationalization of operating expenditure took many forms: reductions in personnel, collective agreements that reduced the lead in remuneration levels against the comparison market, and a major reorganization implying decentralization and a reallocation of resources. These steps allowed Hydro-Québec to come through the crisis effectively and to substantially boost overall productivity.

From 1982 to 1986, installed capacity grew by 27.9%; sales of electricity rose by 39.1% and customer accounts by 11.6%. During the same period, the number of permanent employees dropped to a level below that of 1982. While quality customer service was emphasized, the utility managed to do more with fewer employees.

However, in spite of the improvement in the utility's financial situation, achieved mainly by cutting operating expenditure, productivity must continue to increase.

Therefore, dialogue with the utility's partners and the desire to bring human resources management more up to date were stressed in 1987. Last year's plan included two major objectives:

- greater collaboration with employees to harmonize their aspirations with Hydro-Québec's objectives;

- a review of human resources management practices and policies to harmonize the utility's needs with those of its human resources.

9.1.1 Continuation of Collaborative Efforts

The proposed strategies involved four groups of employees: first-level managers, employees with substance abuse problems, pensioners, and women. In all these cases, special programs were initiated and are continuing.

TABLE 20
POSITIONS AND EMPLOYEES

	1982	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
PERMANENT POSITIONS*									
(Authorized at January 1)	20,584	20,631	19,600	19,400	19,350	19,825	19,825	19,825	19,825
Permanent employees*									
(at December 31)	19,959	18,975	18,560	18,208	18,470	18,933	19,264	19,350	19,450
At January 1	19,482	19,959	18,975	18,560	18,208	18,470	18,933	19,264	19,350
Hired during the year**	802	146	217	595	487	685	656	381	400
Departures during the year									
• retirement	170	871	501	803	114	132	200	170	150
• other	155	259	131	144	111	90	125	125	150
Temporary employees***	3,529	1,986	2,186	3,163	2,749	2,989	3,000	3,000	3,000
Operations	2,520	1,610	1,886	2,788	2,326	2,656	2,665	2,665	2,665
Construction sites	521	262	186	195	242	204	205	205	205
Decrees	488	114	114	180	181	129	130	130	130
Management-SEBJ									
(total person-years)	1,366	982	485	200	121	153	197	265	335

* Excludes subsidiaries.

** Includes the return of employees from subsidiaries.

*** Average based on 26 pay periods.

Discussions in 1987 with Hydro-Québec's newly created association of first-level managers (APCPNHQ) made it possible to reach an agreement early in the year on normative clauses, notably the introduction in 1988 of an experimental training program to create a pool of candidates for five second-level management positions. A proposal was also submitted to APCPNHQ at the end of 1987 on monetary clauses.

For employees with substance abuse problems, agreements have been reached with the CUPE locals on the terms of a special program that began in January 1988 and is currently recruiting volunteers. The provincial association of retired employees (APRHQ) asked to have a permanent office, and the utility has responded favorably. Based on the results achieved so far, these programs can be considered regular activities and need no longer appear as objectives for 1988.

In the area of equality of opportunity, a first group of eight female line workers was trained during the year. Also in 1987, the second program to prepare women for management positions was undertaken. This program, involving 10 positions, is now permanent. In spite of relatively encouraging results, equal opportunity must be vigorously pursued and will therefore appear as one of the 1988 objectives.

TABLE 21
MANAGEMENT INDICATORS

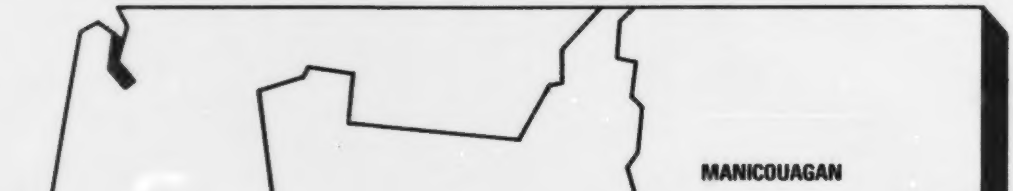
At December 31	***1982***	***1983***	***1984***	***1985***	***1986***	***1987***
Average number of employees per manager	6.7	7.5	8.5	9.5	9.5	9.6
Percentage of employees at head office	22.7	19.7	19.5	17.7	17.4	17.1

9.1.2 *Harmonization of Human Resources Management*

Strategies proposed to update human resources management policies and practices involved occupational safety, remuneration, fringe benefits, work scheduling and contracting out.

Government occupational safety regulations require that some equipment be padlocked to avoid its inadvertent operation. To respect this regulation, the Work Rules were amended and padlocking introduced where facilities allowed. Facilities which do not lend themselves to padlocking will be altered so that it becomes possible. Furthermore, review of the concept of the universality of fringe benefits, and adjustment of the remuneration policy to the economic context and Hydro-Québec's orientations are still under way. In both cases, new proposals are pending.

MAP 7
HYDRO-QUÉBEC'S ADMINISTRATIVE REGIONS


MANICOUAGAN
Baie-Comeau
SAGUENAY
LA GRANDE RIVIÈRE
Chicoutimi
Noranda
Rimouski
MATAPÉDIA
MAURICIE
MONTMORENCY
Québec
LAURENTIDES
Trois-Rivières
Saint-Antoine-des-Laurentides
Varennes (IREQ)
Saint-Hyacinthe
RICHELIEU
MAISONNEUVE
SAINT-LAURENT

Progress can also be reported on work schedules. Flexible hours were introduced in 1987 for clerical and technician positions and a proposal was made to the CUPE locals regarding leaves with deferred salaries. Intensive discussions with union representatives took place throughout the year on contracting-out provisions of the collective agreement. A parliamentary committee hearing allowed the utility to present its position on the subject.

The signing of a collective agreement with Hydro-Québec's engineers' union was the outcome of the latest round of negotiations. The number of permanent employees increased within forecast levels, so that 1987 can be described as a year of consolidation. This orientation will continue, with attention focused on improving the utility's productivity.

TABLE 22
*BREAKDOWN OF PERMANENT EMPLOYEES-DECEMBER 1987**

Job group / Administrative units	Managers	Specialists	Engineers	Technicians	Clerical	Trades	Constables	TOTAL
Regions								
La Grande Rivière	136	111	32	127	244	420	0	1,070
Laurentides	214	132	39	137	690	807	0	2,019
Maisonneuve	175	153	94	364	268	679	0	1,733
Manicouagan	94	56	24	139	158	418	0	889
Matapédia	69	61	12	66	200	244	0	652
Mauricie	209	126	106	233	413	771	0	1,858
Montmorency	193	138	41	188	578	714	0	1,852
Richelieu	175	118	34	143	568	637	0	1,675
Saguenay	64	38	15	62	126	211	0	516
Saint-Laurent	193	203	40	54	863	642	0	1,995
Total	1,522	1,136	437	1,513	4,108	5,543	0	14,259
• Men	1,476	965	422	1,494	2,045	5,519	0	11,921
• Women	46	171	15	19	2,063	24	0	2,338
Head office	389	1,296	327	104	878	127	116	3,237
Engineering and construction	169	154	208	153	233	2	0	919
IREQ	37	44	163	134	73	67	0	518
Total	595	1,494	698	391	1,184	196	116	4,674
• Men	551	1,141	669	384	351	186	109	3,391
• Women	44	353	29	7	833	10	7	1,283
TOTAL Hydro-Québec	2,117	2,630	1,135	1,904	5,292	5,739	116	18,933
• Men	2,027	2,106	1,091	1,878	2,396	5,705	109	15,312
• Women	90	524	44	26	2,896	34	7	3,621

* Excluding subsidiaries.

9.2 Salary Levels and Reduction in Remuneration Lead

The average annual base salary of permanent employees at the end of 1987 was $39,724, an increase of 3.6% on 1986. Salary increases were based on agreements with the utility's unions and increases granted to non-unionized groups for 1987. Scale increases were 3.5% for the Clerical, Trades, Technicians, Constables and Managers groups, 3% for Specialists and 2% for Engineers.

These salary increases are less than the 3.5 to 4.5% increases granted by Québec companies as a whole. It should also be noted that inflation, as measured by the Canadian Consumer Price Index stood at 4.3% during the same period.

With the additional impact of 1986 increases, the remuneration lead identified in 1985 is progressively being reduced. Between 20 and 30% of the lead, depending on job group, is estimated to have been eliminated during the 1985-1987 period. When added to the reductions obtained between 1982 and 1985, the lead was reduced by an average of 45% in the 1982-1987 period.

9.3 The Issue of the Future: Productivity

In order to retain its competitive position on the energy market, Hydro-Québec intends to hold rate increases close to the inflation rate. The utility also aims to re-establish its financial margin for maneuver, so that any future economic shocks can be absorbed. Increased productivity must therefore remain a major objective. However, previous steps to increase productivity were mainly general in nature. They must now be accompanied by more specific measures.

In the human resources area, the increase in the number of permanent and temporary employees will continue to be limited over the coming years. For all practical purposes, the utility generally appears to have sufficient human resources to deal with the challenges of the future. Moreover, efforts to find a balance between inside and outside resources will continue.

However, better utilization of human resources already available must be ensured. The emphasis here will be on obtaining greater flexibility in resource allocation. This may mean adjustments in both planning and executing tasks. In upcoming negotiations, efforts to restore overall remuneration to levels more in keeping with the comparison market will continue, to improve productivity. On the other hand, the utility will intensify its human resource development programs, to see that its employees are better equipped to face these challenges. It will also stress training and collaboration in safety aspects.

Short-term action will focus on four major objectives: productivity, training, safety and equality of opportunity.

9.4 Objectives and Strategies

OBJECTIVE 1

Continue to improve the productivity of human resources.

STRATEGY

Introduce measures to increase productivity.

In light of growing interest in productivity and a consensus on relatively universal indicators, the concept must now be developed for application to specific units or activities. Given the goal of greater profitability in power-system operation, special emphasis will be placed on human resources productivity in generating facilities by a review of current procedures and the formulation of appropriate measures.

OBJECTIVE 2

Introduce new training programs and adapt those already in place to better respond to the management training or professional development of specific groups of unionized, non-unionized or management employees.

STRATEGIES

1. Pursue the introduction of and constantly improve measures promoting management performance that clearly establish the utility's expectations from its managers and serve as the keystone of all management activities.

This program is intended to enhance individual performance by providing planning, follow-up and evaluation measures that will improve management quality and performance. It also includes assessment of training needs, career planning guidance and remuneration on the basis of merit.

2. Develop the skills of middle management in current positions for greater competence within the utility.

One way to achieve this objective is to adjust and develop integrated training programs adapted to the utility's management philosophy and suited to the needs of decentralization and enhanced managerial responsibility. These programs involve such fields as planning, cost management, supervision, control, and communications, and the use of resources in general.

TABLE 23
PERMANENT EMPLOYEES BY UNION AFFILIATION

Union	Permanent employees at December 31	
	1986	1987
• Syndicat Professionnel des ingénieurs de l'Hydro-Québec	1,098	1,109
• CUPE* Local 957 Technicians	1,866	1,891
• CUPE Local 2000 Clerical and PLT-CL (Transmision- Line projects and construction)	5,037	5,076
• CUPE Local 1500 Trades	5,363	5,618
• CUPE Local 1500 Dispatchers	123	118
• Fraternité des constables spéciaux d'Hydro-Québec	116	116
TOTAL	13,603	13,928

* Canadian Union of Public Employees.

OBJECTVE 2

STRATEGIES

3. Understand and develop the utility's labor relations values, to improve the quality of relations with employees and unions.

This program seeks to give each participant and each unit an opportunity to identify and analyze their labor relations values and compare them with those proposed by the utility and see how they can be implemented in day-to-day management.

Management at all levels and human resources personnel will be invited to participate in this program. The subjects discussed will involve the dynamics of labor relations, participation and decision-making, management of collective agreements and the work climate in general. When it is completed, each unit will have formulated a labor relations plan.

4. Promote the development of clerical employees.

In their most recent bargaining, Hydro-Québec and the CUPE locals agreed to emphasize the development of clerical employees. Hydro-Québec intends to clarify and reinforce its activities in this area.

OBJECTIVE 3

Improve the utility's industrial accident record.

STRATEGIES

1. Complete in 1988 the introduction of the new Work Rules with adequate training and institute the means to ensure that they are rigorously applied.

   Investigations have frequently found that difficulties encountered in applying the Work Rules were a cause of accidents. Revision of these rules has been widely approved by the health and safety committees in the Trades and Technicians groups. This collaboration should ensure that they are properly implemented.

2. Seek agreement from the provincial Trades Health and Safety Committee on criteria for live-line work on the distribution system.

   Work on distribution lines can be done on live or dead lines. The preparation of criteria to guide that choice has been the subject of many discussions with the provincial Trades Health and Safety Committee. This approach will be finalized in 1988.

OBJECTIVE 4

Retain existing equality of opportunity programs and introduce new programs that will implement the utility's goals in concrete terms.

STRATEGIES

1. Follow-up procedure.

   Quantitative objectives for female representation have been established for each senior officer reporting to the President and Chief Executive Officer. A quarterly follow-up procedure will be instituted to measure the performance of each officer against the quantitative objectives.

   Initially, only management posts are included. Specialists will be subject to the same quantification procedure at a later date.

2. Career planning for female non-unionized clerical employees.

   Special measures will be proposed for female non-unionized clerical employees and secretaries to give them access to specialist positions through internships or retraining them in computer sciences.

3. Preparation for management.

   The utility will continue its efforts to develop the potential of its female employees by ensuring that there are always 10 women undertaking management internships to prepare a pool of candidates for promotion.

4. Greater representation in non-traditional jobs.

   Access of women to non-traditional trades will be promoted by greater recruitment among temporary trades employees and by continuing the experimental program that has now trained 12 women for line work, 8 of whom are already on the job.

5. Introduction of daycare facilities in the workplace.

   Collective agreements already provide some mechanisms for this objective. Two pilot programs are already underway: a daycare centre is in operation at the Des Seigneuries sector of the Richelieu region, and another is being set up in downtown Montreal for head office employees. Although both projects are entirely managed by parents, the utility contributes by providing the premises. Both projects will be evaluated during 1989. This evaluation will be used as the basis for a corporate policy on daycare centres in the workplace.

TABLE 24
*MOBILITY OF PERMANENT FEMALE EMPLOYEES - 1987**

Job group	December 1986		Hirings 1987	Departures 1987	Arrivals in group	Departures from group	December 1987	
	Number	%**	Number	Number	Number	Number	Number	%**
Clerical	2,854	53.8	132	46	4	35	2,909	54.8
Trades	26	0.5	15	7	3	3	34	0.6
Constables	6	5.1	1	0	0	0	7	6.0
Technicians	21	1.1	6	0	0	1	26	1.4
Engineers	47	4.2	0	1	1	3	44	3.9
Specialists	484	18.6	34	6	39	11	540	20.2
Managers	87	4.2	4	4	17	11	93	4.3
TOTAL	3,525	19.0	192	64	64	64	3,653	19.2

* Includes subsidiaries.

** Represents percentage of female employees by job group.

10. FINANCIAL MANAGEMENT

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While existing installations will be maximized with the implementation of supply and demand management strategies, the Québec and external market development strategies will nonetheless entail substantial funding requirements for the construction of new installations. Over the next 10 years, Hydro-Québec plans to invest $39 billion in the target construction program, including $28 billion for generating and transmission facilities. Investments of $7.5 billion are forecast for the first three years of the plan.

TABLE 25
INVESTMENTS IN THE TARGET CONSTRUCTION PROGRAM

(in millions of current dollars)

Type	*1988*	*1989*	*1990*	*1991-1997*	*Total 10 years*	*%*
Generation	540	726	919	15,416	17,601	45
Transmission	797	862	977	7,820	10,456	27
Distribution	581	533	530	4,906	6,550	17
Support and technology	249	273	326	2,741	3,589	9
Grants, loans, investments and advances	73	66	98	460	697	2
TOTAL	2,240	2,460	2,850	31,343	38,893	100

10.1 Financing

The net borrowings necessary for implementing the construction plan total nearly $3 billion for 1988, 1989 and 1990. These additional funds, when added to annual refinancing of more than $1 billion, require regular access to the financial markets. Interest and exchange loss represent an annual expenditure of more than $2.5 billion which is especially sensitive to the fluctuations in the Canadian dollar exchange rate and interest rate movements that directly affect interest expenditures for new issues and floating-rate debt. Continuing strategies are therefore needed to reduce financing costs and exercise tighter management of financial risks.

TABLE 26
STATUS OF FIINANCING STRATEGIES

	At December 31 1986	 1987
Maximize financing in Canadian dollars		
Percentage of debt in C$, including effect of swaps and perpetual debt	51.2	53.9
Give preference to terms of 10 or more years		
Average maturity of the debt issued in the current year	18.9	16.2
Renegotiate outstanding debt when economical to do so		
Renegotiations (in millions of dollars)	1,092	570
Interest saved during the year (in millions of dollars)	8.6	8.1
Reduction in exchange loss (in millions of dollars)	77.4	2.4
Reduce volatility of the cost of debt servicing		
Swaps during the year (in millions of dollars)	1,535	902
Increase the portion of debt at floating rates to reduce interest expenditure in the long term		
Percentage of debt at floating rate, including effect of swaps and perpetual debt	8.6	9.7

OBJECTIVE 1

Minimize financing costs and exercise tighter control of financial risks, in order to reduce their impact on the utility's revenue, rates and dividends.

STRATEGIES

1. Continue to maximize financing in Canadian dollars and use other means to minimize exchange risks. In particular, take advantage of the exchange hedge available from external markets.

2. When negotiating new debt or renewing borrowings, give preference to terms of 10 years or longer, in order to stagger maturities. This will avoid congesting the financial markets in the next 10 years given the large volumes of maturities during this period, and the funding requirements of the development plan.

3. In order to reduce or stabilize the cost of the debt, renegotiate outstanding debt when it is feasible and economical to do so. This renegotiation will also improve the scheduling of maturities.

4. Taking conditions on the financial markets into account, gradually increase floating-rate debt as the financial situation allows. This will allow long-term reduction in interest payments.

5. Examine and introduce methods to reduce the volatility of the cost of debt servicing in the short term and thus lessen its impact on results. Such methods include swaps and forward and options contracts.

10.2 Increase in Overall Risk

Recent developments in Hydro-Québec's financial situation bear witness to its vulnerability to an increasingly unpredictable economic and energy context. This increased sensitivity is a permanent factor which the utility must include in its planning. Moreover, implementation of the development plan's strategies will substantially alter the composition of the risks that could affect the utility.

In the coming years, increased sales of firm electricity in Québec will come mainly from sales to the industrial sector. More than half the increase in firm sales in Québec between now and 2006 will come from industry. This makes Hydro-Québec more vulnerable to economic fluctuations. Risk and profit-sharing contracts now in force with certain large-power customers are intended to provide maximum stimulation to Québec's economic development while recovering, on average through the life of the contracts, the cost of supplying the electricity, so that other customer categories do not bear the burden of discounts traditionally given to attract new industries. However, if the economic situation were to be unfavorable for a few years, these contracts would become temporarily less profitable for Hydro-Québec.

Moreover, development of external markets based on earlier construction of new facilities introduces new uncertainties. These include long-term price formulas not directly related to Hydro-Québec's costs, at least for the second stage of export market development, and the size of individual contracts. The development of the dual-energy market as part of the promotion of off-peak usage also increases revenue uncertainty, as the price of electricity in this market cannot be allowed to deviate substantially from that of its competitors.

Other strategies intended to reduce the utility's average cost may in some years expose it to higher costs. This is part of the compromise between minimizing costs and minimizing risks. Careful management of reservoirs, for example, which reduces fixed costs, could, in exceptional cases of low runoff, necessitate recourse to oil-fired generation or, as a last resort, purchases from neighboring systems. The same risk applies to the strategy of borrowing at floating rather than fixed interest rates. Floating rate debt should be less expensive on average than fixed rate debt but the opposite could occur in certain years.

However, some strategies will reduce certain risks to which the utility is exposed. The external market development strategies reduce the exchange risk by creating a better balance of US dollar inflows and outflows. The same holds true of those market development strategies, both inside and outside Québec, which promote the replacement of sales of surplus electricity by sales of firm electricity and therefore reduce the risks associated with fuel-price fluctuations.

Overall, the development strategies proposed will change the composition of Hydro-Québec's overall risk and increase its exposure. But the utility may be able to reduce its costs of supply and ensure the improved development of water resources by the dynamic and profitable development of Québec and external markets.

10.3 Needed: A Restored Financial Margin of Maneuver

In concrete terms, these risks mean that in some years, Hydro-Québec may face a combination of reduced revenue and increased expenditure. The utility's planning must reflect these eventualities by creating a margin of maneuver that exceeds its minimum financial ratios.

Until 1983, Hydro-Québec was able to maintain its solid financial position while remaining competitive in the marketplace because it had a sound foundation, including a margin of maneuver. In 1984, in spite of electricity surpluses and deteriorating exchange rates, Hydro-Québec achieved its two essential financial ratios: interest coverage of more than 1.0 and capitalization above 25%, and thus was able to pay dividends. However, over the course of the next three years, the utility no longer had the margin of maneuver to absorb additional shocks from the energy and exchange markets. Capitalization fell below the minimum of 25%. Over the last four years, return on equity has been well below the cost of the debt, reaching its lowest level of 3.2% in 1985 before rising to 7.0% in 1987.

TABLE 27
HYDRO-QUÉBEC'S FINANCIAL PERFORMANCE

	1980	1981	1982	1983	1984	1985	1986	1987
Interest coverage	1.18	1.01	1.01	1.04	1.10	1.12	1.15	1.25
Capitalization (in %)	25.5	25.1	26.1	26.6	25.3	24.1	24.0	24.9
Self-financing (in %)	33.8	28.1	35.1	40.3	34.2	35.7	40.6	41.0
Return on equity (in %)	18.6	12.0	15.0	11.7	4.7	3.2	4.4	7.0
Net income (in millions of dollars)	746	559	800	707	301	209	303	508
Profit margin: net income / sales revenue (in %)	30.9	20.2	24.6	19.7	7.3	4.7	6.4	10.0

Without the financial margin of maneuver available in the early 1980s, the deterioration in Hydro-Québec's ratios would have been much greater and its consequences for the utility's and the province's credit ratings much more serious. To avoid such consequences, Hydro-Québec might have been forced to impose substantial rate increases in a very difficult period.

Recent experience has therefore shown the necessity for two actions: restoring the minimum financial ratios in the short term and, in the medium term, creating a financial margin of maneuver by readjusting the financial ratios. If this margin is not achieved, any significant disruption in the external context will result either in abrupt rate increases on the utility's most captive markets, an unacceptable option, or further worsening in the financial ratios, which could undermine the government guarantee. Hydro-Québec's debt presently accounts for 47% of the debt contracted and guaranteed by the Government of Québec, and total provincial debt represents 45% of Québec's GDP, compared to about 30% in Ontario and British Columbia.

A margin of maneuver is thus necessary to ensure rate stability and allow borrowing at advantageous terms. This is of fundamental importance if Hydro-Québec is again to invest in major generating facilities in the early 1990s. It is also crucial in establishing a dividends policy in keeping with the profitability and self-financing requirements.

OBJECTIVE 2

Firstly, by the end of 1988, restore or maintain three of the four traditional minimum financial ratios: interest coverage equal to or greater than 1.0; capitalization equal to or greater than 25%; self-financing equal to or greater than 30%.

Secondly, reconstitute a margin of maneuver by restoring a traditional rate of return on equity that is greater than the average cost of the debt and by improving all financial ratios to better reflect the utility's risks.

STRATEGIES

1. Continue cost-reduction efforts, maintaining the strategy of limiting the growth of operating expenditure and gradually applying supply, demand and debt management strategies.

2. In developing export markets, seek to maximize unit sales revenue associated with existing surpluses and to attain a level of profitability for new contracts that is compatible with their specific risks.

3. Establish electricity rates according to a policy that incorporates a better notion of the average cost of production and provides for a return on equity that is greater than the cost of the debt.

In this way, the margin of maneuver can be restored by actions that have a positive impact on revenue from the Québec and external markets, and on expenditure levels, and that improve overall profitability. Return on equity for example, which was 7.0% in 1987, should in the medium term exceed the average cost of the debt.

As far as revenue is concerned, the margin of maneuver will be restored by the absorption of the supply-demand imbalance, allowing kilowatthours now sold at discount on the surplus energy markets to be sold at prices that better reflect the true costs of supply. Surpluses will decrease considerably in coming years and Hydro-Québec will be able to ensure their optimum management while maximizing the resulting revenue. Québec sales of surplus electricity at prices below cost of supply will be substantially reduced after 1988, with the expiry of the industrial boiler contracts. Export surplus energy sales will be gradually abandoned, starting with the least lucrative market, the replacement of coal generation, followed by oil-generation replacement, and will gradually give way to much more profitable sales of firm power and energy.

The application of the rates policy, which seeks an average return on equity in the Québec markets of 13%, will also help restore the margin of maneuver. Rate increases should on average follow the overall inflation rate. If increases clearly below inflation were to be allowed in the short and medium term, it would be impossible to rebuild a margin of maneuver compatible with the utility's overall risk.

As far as expenditure is concerned, recovery of the utility's financial health and rebuilding of the margin of maneuver will also result from cost-reduction strategies that include:

- continuation of the strategy for restraining operating expenditure;

- rigorous management of investments;

- supply management with optimization of reservoir management and generating capacity, thereby reducing base-load investment requirements;

- demand management with dual-energy and interruptible power programs, for reduction of peak-load requirements;

- debt management with increased floating rate debt, so that long term interest expenditure can generally be reduced.

10.4 Financial Framework of the Target Scenario

The financial framework of the target scenario presents the source and application of funds needed for Hydro-Québec to perform its mission and implement its development plan. It is thus a financial forecast based on the utility's current situation and financial management orientations, as well as a series of hypotheses drawn from the most credible economic and energy scenarios.

Reabsorption of the supply/demand imbalance, rates increasing at close to the inflation rate and cost-reduction strategies will all help improve the financial situation.

As of 1988, three of the essential financial ratios will have achieved their minimum level. Interest coverage and self-financing are now above 1.0 and 30%, respectively. Capitalization will achieve its minimum level of 25% in 1988, and return on equity, which is improving constantly, will in the medium term exceed the average cost of the debt.

TABLE 28
MAIN PARAMETERS OF FINANCIAL FRAMEWORK OF TARGET SCENARIO

	1986	*1987*	*1988*	*1989*	*1990*
Rate of growth of Québec's real gross domestic product (in %)	3.3	5.0	2.8	1.5	2.5
Volume of sales (in terawatthours)					
Sales of firm electricity in Québec	103.5	110.4	115.9	120.5	125.1
Sales of surplus electricity in Québec	13.7	13.7	11.4	2.2	0.4
Export sales	26.9	28.8	23.9	23.1	23.5
Total sales	144.1	152.9	151.2	145.9	149.0
Rate of growth of sales volume (in %)					
Sales of firm electricity in Québec	6.0	6.7	5.0	4.0	3.8
Sales of surplus electricity in Québec	13.2	0.0	-16.8	-80.7	-81.8
Export sales	11.2	7.1	-17.0	-3.4	1.7
Total sales	7.6	6.1	-1.1	-3.6	2.2
Average rate increase* (in %)	5.4	4.6	4.5	4.5	4.5
Rise in the Canadian consumer price index (in %)	4.1	4.4	4.6	5.0	4.5
World price of a barrel of crude oil (in US$)	15.1	19.2	18.0	18.5	20.0
Interest rates on Hydro-Québec bonds (10 years and over) (in %)					
Canadian market	9.9	10.4	11.4	10.7	10.5
US market	9.1	9.6	10.5	9.6	9.9
Rate of exchange of Canadian dollar at December 31					
US dollar	0.724	0.769	0.758	0.75	0.75
Deutsche Mark	1.39	1.21	1.17	1.13	1.11
Swiss Franc	1.17	0.98	0.96	0.94	0.92
Yen	114.5	93.1	91.3	87.8	85.1

* On May 1 of each year, according to assumptions used for 1988, 1989 and 1990.

TABLE 29
FINANCIAL RESULTS OF TARGET SCENARIO

(in millions of dollars)

	1986		1987		1988		1989		1990	
	$	%	$	%	$	%	$	%	$	%
Average rate increase		5.4		4.6		4.5		4.5		4.5
Revenue										
Firm electricity - Québec	3,857	8.9	4,183	8.5	4,526	8.2	4,908	8.4	5,287	7.7
Surplus electricity- Québec	167	-20.1	144	-14.2	137	-4.9	38	-72.3	9	-76.3
Electricity exports	649	-3.6	713	9.9	647	-9.3	648	0.2	687	6.0
Other operating income	61	-11.6	55	-8.3	67	21.8	70	4.5	73	4.3
Total	4,734	5.4	5,095	7.6	5,377	5.5	5,664	5.3	6,056	6.9
Expenditure										
Operations	1,129	-2.9	1,246	10.2	1,358	9.0	1,429	5.2	1,505	5.3
Other	854	8.5	899	5.4	978	8.8	1,044	6.7	1,124	7.7
Total	1,983	1.7	2,145	8.1	2,336	8.9	2,473	5.9	2,629	6.3
Income before interest and exchange loss	2,751	8.2	2,950	7.3	3,041	3.1	3,191	4.9	3,427	7.4
Interest and exchange loss										
Interest	2,259	8.9	2,170	-4.0	2,134	-1.7	2,187	2.5	2,220	1.5
Exchange loss	189	-26.7	272	44.2	324	19.1	363	12.0	360	-0.8
Total	2,448	4.9	2,442	-0.3	2,458	0.7	2,550	3.7	2,580	1.2
Net income	303	45.0	508	68.3	583	14.8	641	9.9	847	32.1
Dividends likely to be declared	0		0		189		275		396	
Expenditure, interest and exchange loss	4,431	3.5	4,587	3.5	4,794	4.5	5,023	4.8	5,209	3.7
Gross interest	2,412	3.9	2,413	0.0	2,458	1.9	2,561	4.2	2,653	3.6
Investment										
Gross investment	1,566	-8.1	1,688	7.7	2,240	32.7	2 ,460	9.8	2,850	15.9
Less : Interest charged to construction in progress	128	-29.1	192	49.5	278	44.8	347	24.8	409	17.9
Net investment	1,438	-5.6	1,496	4.0	1,962	31.1	2,113	7.7	2,441	15.5
Borrowings										
Net issue of bonds	1,809	-7.3	1,842	1.9	1,744	-5.3	1,887	8.2	2,607	38.2
Less : Redemption of long-term bonds	1,050	-14.5	1,541	46.7	873	-43.3	990	13.4	1,347	36.1
Net borrowings	759	4.8	301	-60.2	871	189.4	897	3.0	1,260	40.5

TABLE 30
PRINCIPAL FINANCIAL RATIOS

	1986	1987	1988	1989	1990
Interest coverage	1.15	1.25	1.25	1.26	1.30
Capitalization (in %)	23.95	24.87	25.00	25.00	25.00
Self-financing (in %)	40.55	41.01	43.08	39.69	35.64
Return on equity (in %)	4.40	7.00	7.54	7.91	9.95

Interest coverage =

$$\frac{\text{Income before interest and exchange loss + Net investment income}}{\text{Gross interest coverage *}}$$

Capitalization =

$$\frac{\text{Shareholder's equity}}{\begin{array}{c}\text{Shareholder's equity + Long-term debt}\\ \text{+ Notes payable + Long-term debt payable within one year}\\ \text{+ Perpetual debt}\end{array}}$$

Self-financing =

$$\frac{\text{Total income from operations - Declared dividends}}{\text{Investment + Redemption of long-term debt}}$$

Return on equity =

$$\frac{\text{Net income}}{\text{Shareholder's equity (average of year)}}$$

* Interest on long term debt + Interest on perpetual debt + Interest on bank advances and notes payable + Amortization of debenture discount and expenses.

10.5 Sensitivity Analysis

Financial forecasting is much affected by the vagaries of the economic and energy context, and its underlying assumptions can be subject to major variations. In the short and medium term, oil prices and the Canadian dollar exchange rate are the variables that will probably cause the greatest variation in the utility's financial forecast, although interest rates are another potentially disruptive element.

The current financial forecasts assume a context of economic growth. As the experience of recent years has shown, however, variations in economic parameters could have a major impact on the financial results shown here.

TABLE 31
SENSITIVITY OF 1988 NET INCOME

Parameter	***Variation***	***Variation in net income (in millions of dollars)***
Volume of sales of firm electricity in Québec	+1%	45
Volume of sales of surplus electricity in Québec	+1%	1
Volume of export sales	+1%	6
Rates	+1% as of May 1	27
World price of crude oil	+ US$1 per barrel	22
Operating expenditure	+1%	-14
Interest rates	+1%	-21
Exchange rate of Canadian dollar (in US$)	+ US$0.01	10
Exchange rate of Canadian dollar against a basket of currencies other than the US$	+1%	14

10.6 Comparison of the Principal Elements of the Financial Framework for 1987 and 1988

Three factors were primarily responsible for the improvement of the 1987 financial results: firming oil prices, appreciation of the Canadian dollar against the US dollar, and vigorous economic activity. The result has been that Hydro-Québec completed fiscal 1987 with a net income of $508 million, against a forecast net income of $337 million in the 1987-1989 Development Plan.

The price of oil has risen rapidly over the last year. Forecast to reach US$18 per barrel only in 1989, the 1987 average was US$19.2, US$4.1 higher than in 1986.

Economic growth was greater than in 1986, whereas a slowdown had been forecast.

And last year's plan predicted a worsening in the exchange rate against all currencies. However, although the Canadian dollar lost ground against European currencies and the Japanese yen, it gained substantially against the US dollar.

For 1988, forecasts of oil prices and the value of the Canadian dollar compared to the US dollar have been raised. These however will not be sufficient to offset the drop in surplus electricity sales, the decline in value of the Canadian dollar against European currencies and the Japanese yen, and the application, in May 1988, of a rate increase lower than that forecast in the previous plan. As a result, the forecast net income for 1988 is $583 million, instead of $675 million.

TABLE 32
COMPARISON OF FINANCIAL FORECASTS

(in millions of dollars)

	1987			**1988**		
	Plan 87-89*	**Plan 88-90**	**Variance**	**Plan 87-89***	**Plan 88-90**	**Variance**
Average rate increase (in %)	4.6	4.6	0.0	5.2	4.5	-0.7
Revenue						
Firm electricity-Québec	4,181	4,183	2	4,493	4,526	33
Surplus electricity-Québec	119	144	25	151	137	-14
Electricity exports	641	713	72	677	647	-30
Other operating income	62	55	-7	65	67	2
Total	5,003	5,095	92	5,386	5,377	-9
Expenditure						
Operations	1,196	1,246	50	1,314	1,358	44
Other	911	899	-12	966	978	12
Total	2,107	2,145	38	2,280	2,336	56
Income before interest and exchange loss	2,896	2,950	54	3,106	3,041	-65
Interest and exchange loss						
Interest	2,282	2,170	-112	2,208	2,134	-74
Exchange loss	277	272	-5	223	324	101
Total	2,559	2,442	-117	2,431	2,458	27
Net income	337	508	171	675	583	-92
Dividends likely to be declared	0	0	0	0	189	189
Expenditure, interest and exchange loss	4,666	4,587	-79	4,711	4,794	83
Gross interest	2,502	2,413	-89	2,573	2,458	-115
Investment						
Gross investment	1,902	1,688	-214	2,674	2,240	-434
Less : interest charged to construction in progress	186	192	6	350	278	-72
Net investment	1,716	1,496	-220	2,324	1,962	-362
Interest coverage	1.17	1.25	0.08	1.21	1.25	0.04
Capitalization (in %)	23.97	24.87	0.90	24.80	25.00	0.21
Self-financing (in %)	35.41	41.01	5.60	41.55	43.08	1.53
Return on equity (in %)	4.69	7.00	2.31	8.77	7.54	-1.23

* According to the 4.6% rate increase granted in May 1987 : The previous development plan assumed 4.9%.

10.6.1 Revenue Comparison

The revenue from sales of firm electricity in Québec in 1987 was slightly higher than the forecast $4,181 million, reaching $4,183 million. The result would have been even higher except for the mild temperatures that particularly affected sales in the residential and farm sector. Economic growth and the remarkable success of the dual-energy program resulted in above-forecast sales in the general, institutional and industrial sectors.

For 1988, it is expected that sales associated with the marketing programs will exceed the forecast in last year's plan by 3 terawatthours. However, the projected rate increase for the May 1988-May 1989 period is 4.5%, rather than the 5.2% indicated in the last plan. Anticipated revenue from sales of firm electricity in Québec will be $4,526 million, or $33 million more than forecast.

Revenue from sales of surplus electricity in Québec and on export markets was higher than forecast in 1987, mainly because of the improvement in unit prices caused by firming oil prices.

However, the utility's decision to raise the water levels in its reservoirs in order to have additional reserves of energy, to allow increases of sales of firm electricity on more lucrative markets, will result in reducing the volume of surplus sales in 1988. Thus, the new forecast of revenue from sales of surplus electricity, both in Québec and on export markets, is $44 million or 5.3% less than in last year's plan.

10.6.2 Expenditure Comparison

1987 operating expenditure was $50 million or 4.2% higher than forecast in the last plan. This difference arises mainly from the reduced operating expenditure charged to construction in progress and various write-offs. In 1987, the utility caught up with a backlog in corrective maintenance of its installations and expects to intensify preventive maintenance associated with power system management in 1988. Plans include intensification of current efforts in marketing and quality of service. The effect of these measures is to increase the operating expenditure forecast for 1988 by 2.5%.

Other expenditure categories will also increase in 1988 because of the readjustment of the depreciation of fixed assets and adjustment of taxes.

10.6.3 Interest Comparison

Interest expenditure in 1987 was $112 million lower than the forecast in the previous plan, mainly because of the appreciation of the Canadian dollar against its US counterpart. The 1988 forecast has been slightly lowered because of the upward adjustment of the Canadian-US dollar exchange rate and reduction of the borrowing program in 1987 and 1988.

10.6.4 Exchange Loss Comparison

Exchange loss management in 1987 enabled the utility to hold this expenditure within the amounts forecast in last year's plan. In 1988, however, the value of the Canadian dollar against European currencies and the Japanese yen should be lower than forecast in the previous plan, and with the one-year reduction in the amortization period for unrealized exchange loss for debt denominated in these currencies, there will be a major increase in this expenditure, which is expected to rise to $324 million, or $101 million more than forecast last year.

10.6.5 Dividend Comparison

The dividends likely to be declared in 1988 now stand at $189 million, whereas the previous plan did not anticipate any dividends for 1988. This variance is explained by the fact that the capitalization ratio forecast for 1988 in this plan is 25.0%, the minimum required by the Hydro-Québec Act before dividends can be declared. The increase in capitalization ratio from 24.8% to 25.0% is primarily due to a better financial result in 1987 than had been anticipated. The capitalization ratio at the end of 1987 reached 24.9%, whereas it had been forecast in the *Hydro-Québec Development Plan 1987-1989* to reach only 24.0%.

10.6.6 Investment Comparison

Net 1987 and 1988 investment is $220 and $362 million lower, respectively, than forecast in last year's plan. This reduction is due to the postponement and rebudgeting of certain projects, the re-evaluation of the generating station rebuilding program, modification of the plan to reinforce the Daniel Johnson Dam and the review of capital spending for automation, telecommunications and support equipment.

11. THE IMPACT OF HYDRO-QUÉBEC'S STRATEGIES ON ITS PARTNERS

Hydro-Québec activities must be seen within a context of objectives that include the expectations of its partners: its customers, the government as its shareholder and its lenders. This context, which is specific to Hydro-Québec, determines its choice of strategies and the criteria by which its performance may be judged.

Hydro-Québec is first and foremost a public utility, responding to the needs of Québec for electricity at the best possible terms. There must be a reasonable balance between service quality, rate levels and rate stability. Furthermore, Hydro-Québec must assume the responsibilities conferred on it by its sole shareholder, the government. It must actively seek out profitable market development options and, for the benefit of Québec as a whole, attempt to optimize the socio-economic advantages of exploiting hydroelectricity. In addition, it is incumbent on Hydro-Québec, in collaboration with the other land-use planners and developers, to ensure the rational use of natural resources when building or operating facilities. The utility must also take into account the requirements of the financial markets, so that it can continue to borrow at advantageous terms.

Discussion of how these strategies are inter-related will be followed by an examination of the compromises made to reconcile the occasionally contradictory expectations of Hydro-Québec's various partners and a description of the socio-economic spinoffs of Hydro-Québec's strategies for Québec.

11.1 Consistency and Interrelationship of Hydro-Québec Strategies

As indicated in Chapter 2, Hydro-Québec's dual role as public utility and agent of socio-economic development causes it to focus its development plan on three main concerns: development of Québec markets, development of external markets and cost reduction.

At the core of Hydro-Québec's concerns is the need to reduce costs of supply in order to keep Québec hydroelectricity competitive on both Québec and export markets, without sacrificing the utility's environmental objectives in the process.

Several strategies help reduce the cost of supplying electricity. Supply management strategies make it possible to increase the output of existing hydroelectric facilities. Demand management strategies seek a more efficient use of energy by promoting peak-load shaving and off-peak usage. The rates policy also contributes to achieving greater efficiency in the use of electricity by gradually readjusting rates to reflect the average costs of supply to various categories of customer. Technological development strategies help reduce the costs of electricity generation, transmission and distribution, while other strategies, such as those involving debt management and human resource productivity, are part of the overall concern for cost-reduction.

Furthermore, the role of Hydro-Québec as a major lever of economic development requires that the utility actively seek profitable market development options so as to exploit Québec's hydroelectric resources. The cost reduction strategies have a major impact on the competitive position of hydroelectricity and the development of Québec and external markets. To enhance the advantages provided by reduced costs of supply and promote industrial expansion in Québec, Hydro-Québec offers its industrial customers risk and profit sharing contracts. The electrotechnologies promotion strategy is also part of this approach, since the efficient use of electricity makes industrial customers more competitive. The three-stage export development strategy and the long-term price formulas also rely on successful cost reduction to ensure increased penetration of export markets. And the strategies involving reliability of supply and construction of additional plant are essential to the development of Québec and external markets.

The strategies adopted by Hydro-Québec seek to satisfy the expectations of its principal partners, while forming a consistent and balanced whole whose components strengthen each other. However, like any company pursuing a multi-faceted goal, Hydro-Québec is seeking objectives that may appear to be contradictory. In such a decision-making context, compromises must be found to optimize the satisfaction of the various partners. The compromises primarily involve the rates strategy and the strategies that affect Québec's economic activity.

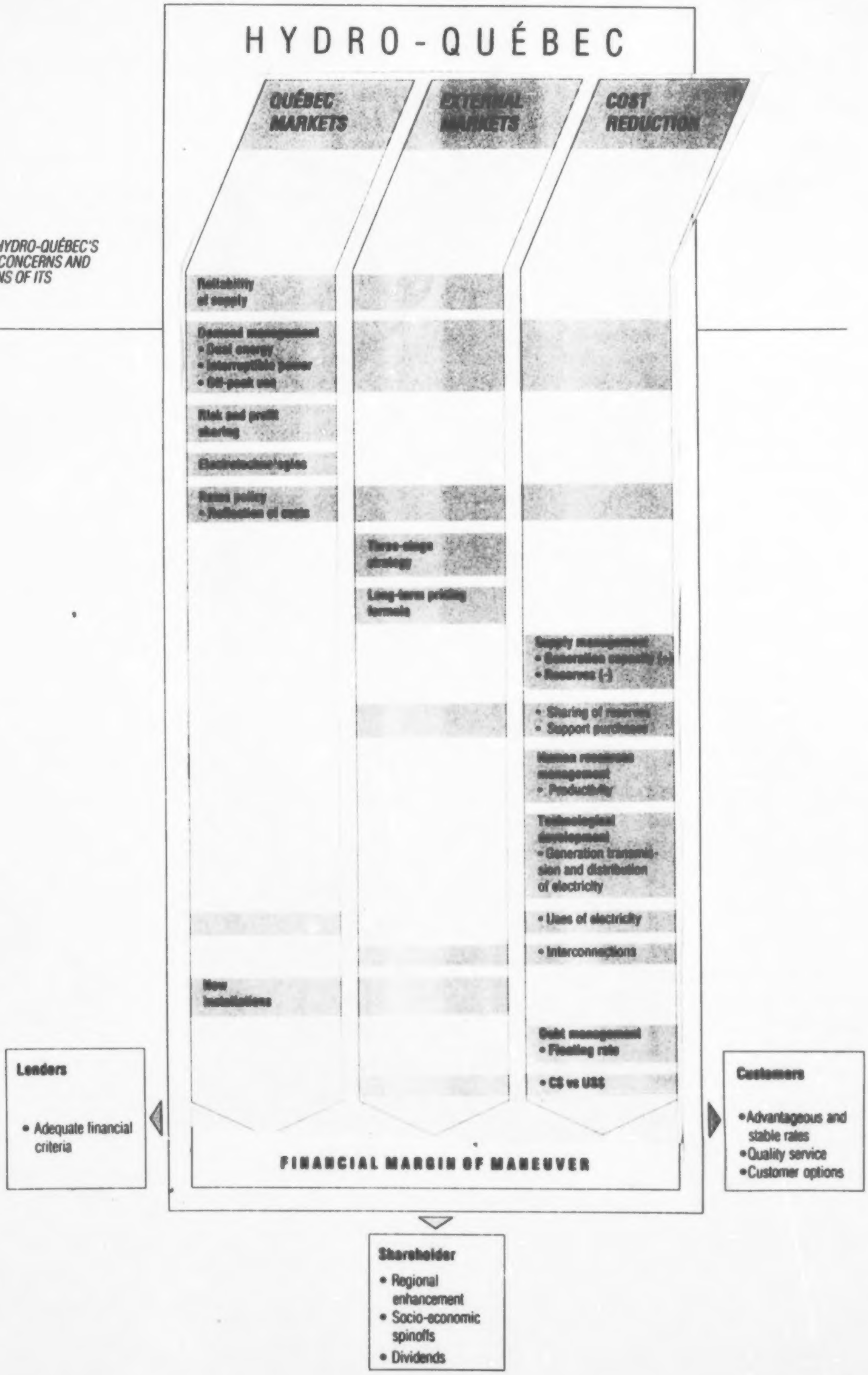

HYDRO-QUÉBEC
QUÉBEC MARKETS
EXTERNAL MARKETS
COST REDUCTION
Reliability of supply
Demand management
• Dual energy
• Interruptible power
• Off-peak use
Risk and profit sharing
Electrotechnologies
Rates policy
• Reflection of costs
Three-stage strategy
Long-term pricing formula
Supply management
• Generation capacity (-
• Reserves (-)
• Sharing of reserves
• Support purchases
Human resources management
• Productivity
Technological development
• Generation transmission and distribution of electricity
• Uses of electricity
• Interconnections
New installations
Debt management
• Floating rate
• C$ vs US$
FINANCIAL MARGIN OF MANEUVER
Lenders
• Adequate financial criteria
Customers
• Advantageous and stable rates
• Quality service
• Customer options
Shareholder
• Regional enhancement
• Socio-economic spinoffs
• Dividends

FIGURE 27
LINKS BETWEEN HYDRO-QUÉBEC'S STRATEGIES, ITS CONCERNS AND THE EXPECTATIONS OF ITS PARTNERS

Compromises affecting the Rates Strategy

The utility's rates policy is a major factor in determining the degree to which it can satisfy its partners. This strategy is therefore central to the compromises of the development plan.

First of all, the rates policy is the result of a balance between the search for the best price signal to guide customer choices, and the desire to keep rate increases as low as possible. The trade-off between these two concerns is reflected in the rates policy recommended by Hydro-Québec. For each of the major categories, rates will progressively reflect the average cost of supply from existing facilities, rather than the higher cost of new facilities, thus allowing the optimal allocation of resources in the economy.

With rates determined according to average cost, customers are not fully aware of the costs associated with satisfying increased demand for electricity. The price signal is even more distorted because rates for some customer categories do not reflect average cost of supply and the opportunity cost is shifted to other categories. In addition to being unfair, this cross-subsidization stimulates demand in the privileged rates category, thereby increasing the burden being shifted to the other categories.

Rates policy must therefore aim to gradually reflect the average cost of supply associated with each of Hydro-Québec's customer categories. However, in order not to prejudice customers, the proposed timing of the adjustments in some rate categories will reflect the constraints of economic evolution and the price of competing forms of energy. Moreover, although costs of supply differ from one region to another, Hydro-Québec will maintain uniform rates province-wide on its interconnected grid, in order to promote regional development.

The second major compromise involves rate levels and stability. Hydro-Québec customers want advantageous rates not only in the short term but also in the long term. They also want stable rates, i.e. rates sheltered from abrupt increases. Hydro-Québec's return requirement is the key to the compromise between these various objectives.

It would be possible in the short term to keep rates artificially low by abandoning the requirement for a normal rate of return on capital. However, capital is a scarce resource. The failure to assign an adequate value to capital when setting rates would encourage the inefficient use of electricity. Resulting over-consumption would necessitate more facilities to satisfy the basic needs of electricity consumers, whereas the same resources could be better utilized elsewhere in the economy. The outcome of this reduced efficiency would be higher unit costs of supply, not only to satisfy Québec demand but also to develop export markets, where our competitive position would be weakened. The short term drop in prices achieved by abandoning the requirement for a normal return on investment would merely be a temporary advantage. In the long term, the effects of the inefficient use of energy would be felt in the price paid for electricity. Moreover, the reduction in revenue from sales and the increase in unit costs of supply would dramatically reduce the financial margin of maneuver sought by Hydro-Québec. This in turn would hinder the application of certain cost-reduction strategies. And the absence of this margin of maneuver would mean that Hydro-Québec could no longer absorb unexpected shifts in its economic and energy environment without imposing sudden rate increases on captive markets for electricity, thus undermining rate stability in the process.

The return requirement retained in setting rates for Québec markets makes it possible to reconstitute the desired margin of maneuver. It is a reasonable requirement and compares favorably to the rate of return granted other public utilities. Moreover, staggering the correction time required to achieve this return takes into account the customer's ability to pay.

The third major compromise involves determining what share of the economic advantages of hydroelectricity is passed on to customers through rates and what share is passed on to society as a whole, the owners of the resource, in the form of dividends.

These two mechanisms differ widely in their manner of distributing the wealth. Excessively low rates would allot all the advantages of hydroelectricity according to current consumption, with the large-power customers necessarily obtaining the greatest benefit. This is not the fairest form of distributing the advantages of a resource that belongs to society as a whole. Furthermore, it would affect consumption of electricity and encourage inefficiency, which is contrary to customer interests and reduces the collective wealth. The rate of return required thus makes it possible to establish a fair balance between the interests of customers and that of society as a whole.

Compromises on Economic Spinoffs

The cost reduction strategies established by Hydro-Québec will make a major long term contribution to creating the financial margin of maneuver needed to ensure rate stability while keeping Québec hydroelectricity competitive. But these strategies will have some impact on the structure and size of the construction program and its economic spinoffs. It would seem then that a compromise would be needed between the interests of customers, who are the principal beneficiaries of cost reduction, and the economic agents participating in construction activities.

However, when all the impacts of these strategies are taken into account, the necessity for compromise turns out to be more apparent than real. Increased efficiency in water resources management assures Québec of a more competitive position, and this in turn bolsters the Québec and external market development strategies, which themselves create economic spinoffs. Moreover, in a context that is uncertain in both the short and the long term, cost reduction is the only way to ensure that the comparative advantages of hydroelectricity are maintained. In addition, one of the main cost reduction strategies, demand management, is in itself a source of economic spinoffs for Québec, whether directly from the installation of dual-energy systems or indirectly from the impact of interruptible-power credits to target industries whose international competitiveness is thereby enhanced.

Likewise, a number of market development strategies recommended by Hydro-Québec require compromise between the risk to the utility and the economic spinoffs associated with its activities. The risk and profit sharing contracts are part of a strategy to promote industrial development in Québec and obtain the associated economic spinoffs. This strategy seeks to enable Québec to obtain maximum benefit from economic development, while recovering the average costs of supply, rather than inflicting on other customers the burden of subsidizing discounts usually given to attract new industries. However, if the economic situation were unfavorable for some years, this strategy would mean a temporary drop in Hydro-Québec's rate of return.

The strategies involving electrotechnology development and demonstration also illustrate the compromises between the risk the utility is willing to take and its desire to maximize the economic spinoffs of its activities by promoting increased productivity among its industrial customers.

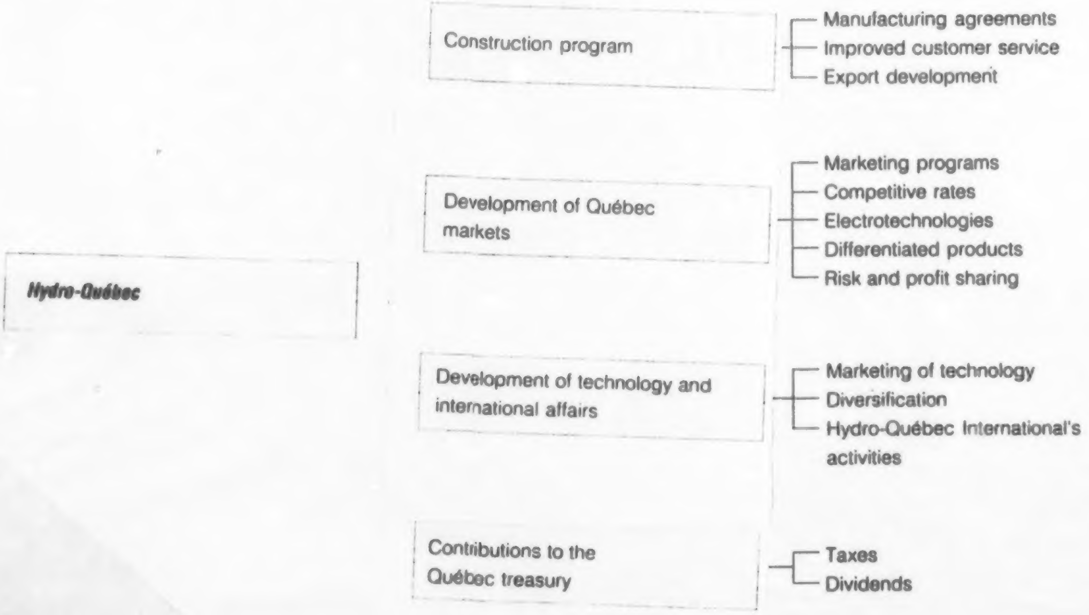
Likewise, strategies involving penetration of external firm energy markets expose the utility to risks that are different from those related to sales of surplus electricity. These include the use of long-term price formulas and the likelihood of energy surpluses at the end of the export contracts. On the other hand, the revenue from export sales and the accompanying economic spinoffs should increase substantially once the commissioning dates of major projects have been moved forward.

11.2 Economic Spinoffs

11.2.1 Job Creation

In coming years, Hydro-Québec will provide many Québec job opportunities from large scale construction. Moreover, marketing programs focusing on electrotechnologies and product differentiation, as well as more appropriate rates formulas, will ensure Québec substantial and on-going participation in the development of electricity-intensive sectors. In the longer term, technology marketing programs and the activities of Hydro-Québec International (HQI) should also contribute to the economic growth of Québec.

TABLE 33
DEVELOPMENT LEVERS AND JOB CREATION


Hydro-Québec
Construction program
Manufacturing agreements
Improved customer service
Export development
Development of Québec markets
Marketing programs
Competitive rates
Electrotechnologies
Differentiated products
Risk and profit sharing
Development of technology and international affairs
Marketing of technology
Diversification
Hydro-Québec International's activities
Contributions to the Québec treasury
Taxes
Dividends

The construction program will bring in its wake major economic spinoffs. More than $7.5 billion will be invested between 1988 and 1990, notably for additional capacity at La Grande 2, work on Radisson and Nicolet substations and construction of the 450 kilovolt direct current line. These activities should allow Hydro-Québec to maintain a team of more than 22,500 permanent and temporary employees for construction and operations, in addition to sustaining on average an equivalent number of jobs through Québec contractors and suppliers.

TABLE 34
JOBS SUSTAINED BY HYDRO-QUÉBEC

(in person-years)

	1986*	1987	1988	1989	1990
Generation, transmission and distribution of electricity					
Jobs related to operations	19,990	22,395	23,135	23,350	23,390
• Direct	15,570	15,680	16,170	16,320	16,380
• Indirect	4,420	6,715	6,965	7,030	7,010
Jobs related to capital investments	15,775	17,185	21,725	22,040	23,540
• Direct	8,265	8,515	10,190	10,305	11,015
• Indirect	7,510	8,670	11,535	11,735	12,525
Total	35,765	39,580	44,860	45,390	46,930
Marketing of electricity					
Jobs related to marketing programs	10,580	4,220	3,785	1,690	770
• Dual-energy	1,775	710	125	210	280
• Electrotechnologies	360	400	195	465	465
• Rate discounts	8,100	3,045	3,440	990	0
• Other	345	65	25	25	25
Jobs related to rate advantages for large-power industries	11,615	7,845	9,100	11,220	11,030
Total	22,195	12,065	12,885	12,910	11,800
TOTAL	57,960	51,645	57,745	58,300	58,730

* Revised figures for 1986.

In the longer term, the target scenario retained by Hydro-Québec features average annual gross investments in the order of $4.5 billion from 1991 to 1997. The size of these investments is directly related to the various strategies recommended by Hydro-Québec to ensure the development of Québec and external markets.

Hydro-Québec's marketing programs mainly focus on large power sectors where the leverage is greatest. Historically, hydroelectricity has attracted major industries to Québec and enabled them to substantially improve their competitive position and domestic and foreign market share. In the final analysis, this has meant more capital investment, more exports of manufactured goods and more jobs for Québec. Indeed, three of the most electricity-intensive industries, pulp and paper, primary metals and chemicals, account for more than one third of Québec exports of manufacturing goods and over 18% of jobs in the manufacturing sector.

In recent years, the international trade context has undergone substantial changes. New products will therefore be offered in order to maintain or improve the competitive position of the utility in industrial development. In addition to electricity rates that are among the world's lowest, industries locating in Québec will find more diversified products in the improved interruptible power program and will be able to reduce their risks by negotiating contracts based on profit and risk sharing. This has been the case with Norsk Hydro and QIT (Québec Fer et Titane).

Attracting large-power industries to Québec is a major economic goal. These industries will require nearly 10,500 person-years of work annually over the next three years, more than 70% of this in permanent employment. Moreover, as the case of Norsk Hydro illustrates, Hydro-Québec's policies will make it possible to strengthen Québec's industrial base by stimulating the emergence of new industrial sectors and the creation of specialized jobs.

Electrotechnologies are also important for Hydro-Québec. Ten projects are now being undertaken at LTEE, Hydro-Québec's electrochemistry and electrotechnology laboratory, in close association with industry. In addition to the $30 million budgeted for LTEE until 1990, major economic benefits should result from the introduction and dissemination of electrotechnologies. These will play a role in the reindustrialization of Quebec, in addition to contributing to the development of electricity expertise that has some export potential. The electrotechnologies program will also provide permanent replacement for the industrial boilers program by improving the energy efficiency of the whole production process.

A total of more than 58,000 person-years of work will be sustained annually by Hydro-Québec activities from 1988 to 1990, more than 60% in jobs available to workers not regularly employed by Hydro-Québec.

11.2.2 Contribution to the Québec Treasury

In addition, Hydro-Québec contributes to the Québec Treasury. This helps keep Québec competitive while reducing the burden on taxpayers. At a time when governments are increasingly concerned about the effectiveness of their tax system, Hydro-Québec's success in obtaining a financial margin of maneuver by applying rates policies that allow a normal rate of return and reflect the costs and risks it has assumed, promotes a more competitive and effective tax system and thereby guarantees a more productive economy.

Because of the economic shocks Hydro-Québec has had to absorb in recent years, no dividends have been paid since 1985. The present tax contribution of Hydro-Québec comprises the capital tax paid by all Québec corporations and a tax on gross revenue from sales of electricity, paid in lieu of real estate taxes. About $330 million annually will be paid to the Government of Québec between 1988 and 1990, in addition to the receipts from the retail sales tax of 9% on electricity sold in Québec and not used for production purposes. In the near future, however, Hydro-Québec's contribution will also take the form of dividends, as a direct result of the return requirement and the financial margin of maneuver that must be restored in order to absorb the risks inherent in the economic and energy environment of the 1990s.

TABLE 35
DIRECT CONTRIBUTIONS TO QUÉBEC TREASURY

(in millions of current dollars)

	1986	*1987*	*1988*	*1989*	*1990*
Taxes	272	289	310	329	347
Dividends	0	0	189	275	396
TOTAL	272	289	499	604	743

11.2.3 Collaboration with Other Land-use Planners and Developers

In addition to its economic development, Hydro-Québec seeks to make an active contribution to Québec's social development. Collaboration with other land-use planners and developers is the preferred way of optimizing the social and environmental spinoffs of its activities.

Regional Enhancement

Since 1985, eligible agencies (such as municipalities, regional county municipalities and native peoples) whose land is affected by new construction projects may carry out regional enhancement. Each new generating, transmission and distribution project, when completed, is part of a program that includes such initiatives. The programs involve collaboration between Hydro-Québec and the agencies concerned and are intended to solve environmental problems and improve quality of life.

In the last three years 10 Hydro-Québec projects resulted in the preparation, by 42 agencies, of joint enhancement programs, containing 105 initiatives for a total of $4.9 million. These include restoring wildlife habitats and cleaning up and landscaping lakes. Hydro-Québec has budgeted some $10.7 million for such programs in 1988.

Multi-purpose Use of Facilities

Increasingly, agencies and industries express the desire to share with Hydro-Québec in the secondary use of certain facilities for the benefit of society as a whole. Bicycle paths and community gardens located in rights-of-way owned by Hydro-Québec and the installation of fishing platforms near a generating station are examples of secondary uses that serve the needs of different groups. Collaboration on multi-purpose use will be continued wherever such use is compatible with the utility's activities.

Permanent Consultative Forum with UPA

The Québec farmers' association, Union des producteurs agricoles (UPA), has had a special relationship with Hydro-Québec for many years now. Most of Hydro-Québec's transmission and subtransmission equipment is located in farming regions or woodlands, and the 1986 agreement between UPA and Hydro-Québec has facilitated the execution of Hydro-Québec activities while respecting the interests and concerns of farmers and woodland operators. The evaluation of line corridors and routes in collaboration with farmers or their local and regional representatives has made it possible to locate transmission towers at land boundaries, often along fence lines. These improvements, as well as woodcutting, stump removal and stone clearing on rights-of-way located in woodlands and near cultivated land, have helped preserve and in some cases even increase the amount of arable land while reducing the inconveniences caused by the presence of towers.

Planning of wood-clearing activities in rights-of-way allows more farmers and woodland operators to do the work themselves, plan the use of their quotas and obtain better prices for the wood. The permanent consultative mechanism established in 1987 will offer both parties an ongoing forum for the discussion of the application of the agreement and other subjects of mutual interest.

Protection of Lifestyle and Economic Development for Native Peoples

The *Mercury Agreement* signed in 1986 by the Government of Québec, the Cree and Hydro-Québec calls for the establishment of a mercury committee to supervise a research and study program on mercury problems at the La Grande Complex. This program has social, cultural, economic and environmental dimensions and also examines the health of local residents. It has a budget of $18 million over a 10-year period, of which $12 million comes from Hydro-Québec. In 1987, the committee provided follow-up of medical monitoring of the Cree population and environmental follow-up of the mercury content of fish from the La Grande complex. The results have allowed officials to revise standards and reduce restrictions on fishing sites, and on species and quantities that can be consumed.

In 1987, more than $110 million was paid to the Cree following the signing of the La Grande Agreement (1986). Of this amount $50 million is for the Cree community fund and $45 million for the fund to aid Cree economic development. The utility is also working with other native peoples of Québec, like the Attikameks, at the draft-design studies stage of its activities.

12. CONCLUSION

. . . .

This development plan advocates the satisfaction of Québec requirements for electricity at advantageous prices but it places the emphasis on the improved development of hydroelectricity.

Beyond the continuation of activities undertaken in recent years, the plan reviews the utility's long term development choices in the context of various growth scenarios on Québec and external markets.

The long term development choices will be implemented as and when the strategies proposed in this development plan are given concrete expression.

The overall strategy is based on improved productivity and optimized supply and demand, integrated with vigorous marketing activity in harmony with rates and quality-of-service policies that seek to satisfy the expectations of the utility's various partners. This strategy, supported by dynamic technological development, enables Hydro-Québec to adequately perform its role as a public utility and broaden its role as an instrument of economic development.

In its scope and its views, this plan constitutes a challenge. Meeting this challenge will allow Hydro-Québec managers and employees to perform worthwhile work with rewarding career opportunities.